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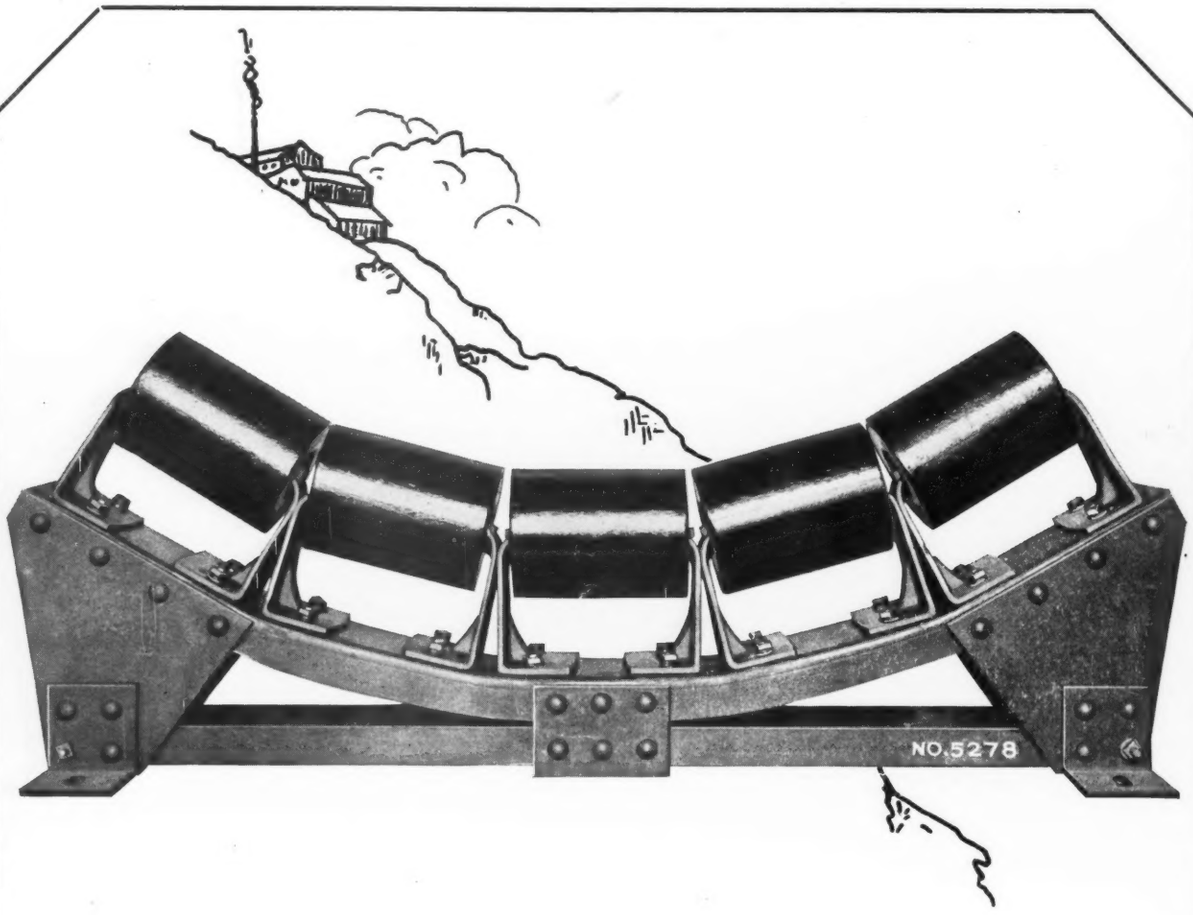
A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

May 19, 1923



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JOSIAH EDWARD SPURR, Editor

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The Stability of Quotations

WE HAVE NEVER CEASED to stress the necessity for an understanding of the principles of marketing of metals and minerals, among those who are engaged in mining or who are contemplating new mining ventures. And as a basis for that, we have devoted much work and much printing space to quoting the prices of metals, minerals, and ores. We do not need here to refer to our quotations for the principal non-ferrous metals, which quotations have long been the commercial standard; nor the extended quotations which we supply for minor metals and minerals. No other journal in the world quotes the full list of metals and minerals, as we do; and no other journal has ever attempted to do it.

Nevertheless, what do quotations mean? A curious lack of comprehension of that point comes to us every now and then, even among those who ought to know better. A quotation represents in general the average figure at which transactions in the metal or mineral take place, so far as we can find out. Just that. Tomorrow the price may be different. Or if you dump a lot of metal or mineral on the market, the price will go down—may even break completely. One would think that the average citizen would understand this simplest of all economic principles; but it appears that that comprehension is not at all universal. Take one of the best-known types of quotation—the quotation of a stock in the New York market. Today it may be ten points below where it was last week. Next week it may be ten or twenty points up. What causes the fluctuation? Manipulation? Speculation? Unfavorable business conditions? Only indirectly. Directly, it is our old friends Supply and Demand. If there are more sellers than buyers, the stock in question goes down; if more buyers than sellers, it goes up.

Take the most classic example of non-ferrous metals, copper. Let us suppose that at any time during the last four years the accumulated stocks of copper had been dumped on the market, for sale at any price. It is difficult to imagine how low the price of copper would have been driven: certainly a low record for all time would have been established. The fact is that the copper market is carefully nursed by those who understand it, as is the lead market, the zinc market, and the markets in general; it would be disastrous for mining if it were not so. Close control is forbidden by the Sherman Act, and is avoided in the United States; but in foreign countries absolute control is not frowned upon and is practiced. Close control of marketing makes the diamond industry possible, for example; without it there would be violent fluctuations, the panics and booms, the business cycles which economists would like to soften or eliminate. The market for other metals and minerals is closely controlled, from the necessity of successful mining. The market price for cobalt is the figure which we quote; it is the price of actual transactions; but there are reserves which if put on the market would smash the price to little or nothing; and a new producer of cobalt would not be able to realize the prices we quote, for he would increase the supply and the price would fall. In short, a common impression of metal quotations is that they are like the price of gold, which the mint pays, no matter what the offerings; but the real comparison is that of the farmer who ships his produce to market, and we all know how bitterly the farmer pays for his lack of knowledge of marketing and his failures to market co-operatively. Co-operative marketing means nursing the market, and that means feeding out the supply carefully. Labor, we grant, is not a commodity: nevertheless the labor unions have grasped the principle of co-operative marketing and of restricting the supply to keep up the price.

A case which showed the peculiar lack of comprehension to which we refer came up recently. A shipment of chrome ore to this country was taken over by a bank which advanced money on it, and was sold for what it would bring. It was dumped on the market, in other words; on a narrow market which did not want it; and it brought only a fraction of the current quotations. Somebody who did not want it bought it in, as one does at an auction—a $500 sideboard for $47.50. Now the question comes to us—were not our quotations wrong? A very little contemplation, a very little common sense, helps in these marketing problems. The chrome ore, like the sideboard, was sold at far less than the actual cost of production, and so the price it brought has little reference to an industrial quotation.

Pittman Act Silver Purchases

THE SUPPLEMENTAL REGULATIONS issued by the Treasury governing the purchase of silver under the Pittman Act (which regulations we published in the news of last week) correct one of the clumsinesses of the first announcement by the Director of the Mint, in that he now recognizes the fact that bullion is produced by mills as well as smelters, and upon the representations of the mill men he has advised he will accept sales for future delivery from any plant which produces bullion. But as yet the Treasury has not modified its earlier equally clumsy decision, not to purchase from the miners the 10,000,000 oz. allotted for subsidiary coinage; nor, so far as we know, has it even given a logical and courteous reply to the arguments presented on behalf of the disappointed and financially suffering miners, showing why it should not keep faith, and purchase the amount of silver which it was announced it would purchase, and upon which mining operations have been planned. Senator Oddie, chairman of the Commission of Gold and Silver Inquiry, is still of the opinion that the decision of the Treasury in this matter cannot be justified morally, or even legally; and the mining industry will not, we hope, so

easily let such a flagrant breach of faith pass by. We do not believe as a rule in wholesale Congressional righting of errors made by the executive branch of the government; but in this case we hope that, if the Treasury proves unwilling to correct its attitude, Congress at its next session will pass a bill providing for the purchasing of the 10,000,000 oz. in question.

One curious sentence in the new Treasury rulings attracts us: "No silver contained in tailings, slag, or mine dumps shall be tendered or accepted." What was the cause of this cryptic utterance? Certainly no silver contained in tailings, slag, or mine dumps will be tendered, because it could not be delivered; because it would not be profitable to produce it at a dollar an ounce, or even more. But who gives the Treasury the authority to state from what type of ore silver shall be produced? The Pittman Act makes it mandatory on the Treasury to purchase new silver of American origin: whether this silver shall be produced from high or low-grade ore, from concentrates or old tailings, is certainly outside of the Treasury's province to dictate. Actually, the quotation shows the complete ignorance of the mining industry and of the silver problem by government officials "dressed in a little brief authority" who have such power over it.

The mining industry suffers from not having a branch of the executive government devoted to its welfare, and of sufficient standing to secure respectful attention in other departments. Therefore, we rejoice at the news that Senator Oddie will renew the old drive for a Department of Mines, taking up the fight left by the regretted sudden death of Senator Nicholson, of Colorado. A bureau, or two bureaus, in the Department of the Interior, will not do: the bureaus are technical, have no voice outside of the Secretary of the Interior, and the average Secretary of the Interior, like the present incumbent, has no knowledge of the mining industry, and little interest in it.

The Trade Association Referendum

THE CHAMBER OF COMMERCE of the United States has announced the result of its referendum on the activities of trade associations, to which we made editorial reference in the April 7 issue. The collective opinion of the members of the Chamber is almost unanimous with regard to certain resolutions. Thus 1,692 members expressed themselves as being in favor of the statement that trade associations should exist for each important branch of industry and commerce; only 6 members were opposed. On the proposition that a trade association should have such a membership that it can be representative of the industry in connection with problems affecting the general advance of the industry, 1,675 votes were counted favorable and 5 opposed.

Almost unanimous agreement was recorded on the question as to whether a trade association should be prepared to consider problems affecting the general advance of its industry or branch of commerce (1,666 in favor and 14 opposed). Resistance was a trifle stiffer to the fifth proposition, which stated that a trade association should continue free from special forms of governmental control (1,596 in favor, 86 opposed). Only 20½—why the ½?—were against the collection of statistics of capacity, production, stocks and sales for its industry, whereas 1,653½ voted yes. The sixth section of the referendum—i.e., statistics of actual prices in closed transactions should be collected by a trade association for its industry—drew an opposition of 133½ votes—again the split vote—with 1,520½ in favor. Resolution No. 7, that any interpretation of statistics or other comment which could induce or facilitate concerted action on the part of members should be omitted by a trade association, was opposed by 130½ members, and 1,487½ voted affirmatively. The final question, that statistics of capacity, production, stocks, sales, and prices should be made as available to the public and to government agencies interested in following the course of the industry and commerce as to its members, brought forth the strongest opposition of all, 282 votes opposed against 1,334 in favor.

The outcome of the referendum leaves no doubt as to the opinion of the members on each issue. In no case was the voting so close that the issue was not clearly decided. Perhaps the most surprising result of the canvas was the pronounced inclination of the voters to favor the collection of statistics relating to prices on closed transactions. It has always seemed to us that a large enough field existed for the use of the trade association without its having anything to do with prices. So soon as a trade association begins to bother with prices, almost every other activity becomes secondary and the trade association soon finds itself treading on dangerous ground. Whenever a trade association has been accused of violating the anti-trust laws it always develops that some activity having to do with prices has been followed. By keeping severely aloof from price statistics of whatever nature, the trade association is assured of having clean skirts, and has a greater opportunity to increase its usefulness in other fields.

"Handling" Labor

SECRETARY HOOVER is quoted as saying that "industry must look to increased efficiency, not only of labor, but in handling labor, to solve its labor problems, rather than to an influx of foreign workers." With this statement we are in agreement. It could be shortened by deleting the words " . . . not only of labor, but . . . " The efficiency of labor means the personal efficiency of the individual worker, and that, it seems to us, depends entirely upon how well the workers are "handled." In other words, the responsibility is squarely up to employers, individually and as a class. A book could be written on the subject, but it seems worth while to enumerate briefly some of the directions in which the employer can exert effort to utilize human energy effectively.

To obtain the maximum efficiency from each worker the employer must do his part toward keeping the employee in such physical condition as will permit him to perform his task properly. The employer is also largely responsible for the mental attitude of the worker toward his task: a desirable attitude is helped by the provision of decent working conditions and an opportunity for a self-respecting existence when not at work; by fair and square treatment by foremen and superintendents; and by pay perhaps just a little better than reasonable. Unless the employee approaches his work in the proper frame of mind, he will not work efficiently.

But even healthy, willing workers can labor ineffectively if the enterprise in which they are engaged is improperly organized. Things must be done in the right order, they must be done only once, there must be a minimum loss of time and effort. Money spent in find-

ing out just what is the best way of doing each operation and in teaching the employees to do it that way is a measure for economy of labor in the end. More foremen and better foremen make for efficiency of operations and reduce the number of workers required.

Energy must not be wasted in doing by hand tedious or laborious operations that can be done by machines. Labor unions sometimes have opposed the introduction of machinery. Such opposition is foolish. Any instrumentality that will accomplish a given result with a smaller expenditure of human effort is to be commended. Better and more economical machines are being devised every day; it is the employer's duty to use them.

The entire industrial structure can stand gradual reorganization so as to reduce greatly the size of certain groups of workers; non-essential groups may even be abolished in time. A minimum of approximately 1,500,000 workers is perpetually out of a job; not because work is scarce, but because of changing from place to place. Much of this excessive turnover of labor can be avoided by the adoption on the part of employers of efficient methods of fitting workers to their jobs.

The lower wages are and the larger the number of available workers, the greater is the waste of human energy. Observe the coolie in the Orient, the Kafir in South Africa, and the native in South America. Rates of pay vary widely; the labor cost of doing any particular thing is constant, within reasonable limits.

The Inarticulate Traveler

MINING ENGINEERS have many opportunities, by reason of extensive travel abroad, to absorb strange atmospheres, to form interesting and educative conclusions, and to color their narratives with bizarre experiences. Mr. R. Gilman Brown, in his presidential address before the Institution of Mining & Metallurgy in London recently, reviewed the progress made in the encouragement and dissemination of technical literature by the mining engineering societies, referring especially to "those massive publications of our elder sister in America"; but he added regretfully that all such contributions are addressed primarily to ourselves and refer to our especial knowledge. They are of benefit only indirectly to those outside our circle and untrained in the arts in which we are familiar. That mining engineers so seldom venture into print to describe travel and to recount adventure is explained by the fact that for some reason or other they are reticent on subjects outside the technic of their profession. But, Mr. Brown continued, "We are all to be congratulated that the author of 'Incidents in the Life of a Mining Engineer' has broken the silence; but the very fact that he has done so, and to such good purpose, only tends to emphasize the silence of the rest of us."

Regret is expressed that mining men generally fail to leave their mark on contemporary affairs outside their professional circle, by sharing their views and experiences with others who need information on conditions in foreign countries. This is attributed largely "to the relative loneliness of our occupation, the lack of human contact with our equals and superiors in mental calibre." As a corrective, it is recommended that more attention be paid to "judicious correspondence and reading, by preference not confined to technical matters." This is excellent advice; we would supplement it by suggesting that every mining engineer who travels should practice literary expression by keeping a diary.

What, however, are the prospects of success for the average mining engineer—an unusually interesting person when it comes to conversational reminiscence—who wishes to break into print with a record of his experiences? Mr. Brown mentioned Mr. E. T. McCarthy as an example of a mining engineer who in late years has attained distinction in the field of non-technical letters. We would supplement Mr. Brown's remarks in this connection with details as to how Mr. McCarthy's two books came to be published. In spite of the author's eminence in the profession of mining engineering, in spite of the value of the narrative as a permanent record of travel and observation, in spite of careful and painstaking presentation, in spite of the fact that the author had decided generously that all profits from the sale of the books should go to the St. Dunstan's Home for Blinded Soldiers—Mr. McCarthy was obliged to finance the venture, which, however, was a commercial success; the Home received over £1,000 from the profits.

Usually when an author has to act thus, doubt is cast on the merits of the narrative. Some publishers who stipulate conditions of this kind merely act as commercial printers. With Mr. McCarthy's books, however, there can be no two opinions as to their sterling qualities as a narrative of intense human interest and educative value. It appears, therefore, that the inarticulateness of mining engineers on non-technical matters —the reason why they achieve so little recognition in contemporary letters—is largely because of competition with professional writers, government officials, and personages such as Margot Asquith and Charley Chaplin.

Mining engineering as a reputable profession lacks non-technical mouthpieces. The work of the chemical engineers has been popularized in an interesting and educative manner by writer-technicians such as Hendrick and Slosson; but the romance of the incidentals attending the practice of mining and metallurgy has received scant attention from engineers in high standing in the profession. Until some equitable plan is devised whereby the mining engineer with an interesting story to tell is relieved of the expense and risk of publication, no adequate or commensurate public attention will be paid to him as an essential figure in contemporary affairs.

The Thirst for Knowledge

WE TRY TO ANSWER all questions concerning the mining industries. Naturally, once in a while a question is asked which requires some little research work, for there are things which we cannot know and explain offhand. But we do our best. Occasionally, however, we receive a larger order than we can fill. Such, for example, as the letter recently received from Galesburg, Ill.:

"Dear Sirs:

"Could you furnish me detailed information on the mining and milling of gold and silver and the various forms of mining, also descriptions of the largest gold and silver mines in the U. S. and the world (laborers engaged and the wages paid) and the various special regulatory mining laws? Any information will be appreciated.

"Very truly yours,

—— ——."

Investigation developed the fact that the applicant was not even a subscriber. We wrote him advising a subscription; by diligent attention to our columns, he could gradually obtain all the information for which he hungered and thirsted.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Use of Peroxides in the Cyanide Process

THE EDITOR:

Sir—The description by D. L. H. Forbes[1] of the application of sodium peroxide in cyaniding a telluride ore at Kirkland Lake is of interest as indicating a revival of the use of peroxides, which has so many times been patented and discontinued.

About twenty years before the appearance of the MacArthur-Forrest process Prof. W. A. Dixon, of New South Wales, carried out a series of experiments on the extraction of gold from refractory ores, using all the chemicals which seemed to hold out any hope of being satisfactory solvents. Potassium cyanide he tried and rejected on the ground of its poisonous character, instability, and relatively high price, but the tests were described in a paper which he read in 1877. Elsner's work on the solution of gold by potassium cyanide had been published in 1844; Dixon therefore appreciated the necessity for the presence of oxygen or some other oxidizing agent, and incidentally experimented with several, including permanganate, bleaching powder, and manganese peroxide.

In 1896 Prof. S. B. Christy, of the University of California, read a paper before the American Institute of Mining Engineers on the "Solution and Precipitation of the Cyanide of Gold." He mentioned tests of various oxidizing agents, including "peroxides of barium, manganese, lead, and sodium," each of which was said to increase the solubility of gold in potassium cyanide solution. "Among the most convenient of these oxidizing agents were peroxide of sodium, peroxide of manganese, and ferricyanide of potassium. These experiments were made in 1892–3." This paper aroused some discussion, notably a "Review" by William Bettel, which appeared in the *South African Mining Journal* of May 8, 1897, severely criticizing Christy's work, but confirming his results in the items of sodium and barium peroxides. Bettel, by the way, was the first president of the Chemical and Metallurgical Society of South Africa, but during the war he sided with the Boers; his name was therefore expunged from the roll of past presidents, but was later restored.

For ten years or more after the issue of the MacArthur-Forrest patents it was the fashion to patent anything and everything which by any chance might be expected to influence the effect of cyanide on gold. For instance, one pair of inventors claimed the use of acetylene and calcium carbide, in one patent as an accessory solvent of gold, and in another as a precipitant. Most of the possible oxidizers were covered in an early Transvaal application by H. F. Julian.

J. C. Montgomerie, manufacturer of the "Water of Ayr" hones, took out a number of patents in various countries during this period, bearing on details of the cyanide process. Several mentioned the use of compressed air or oxygen, ozone, or hydrogen dioxide. Some involved the use of "an alkaline dioxide, such as sodium dioxide" with or without the addition of compressed air, caustic soda, and nitrates. In conjunction with Henry Parkes he also patented the use of barium dioxide together with caustic alkali and ammonium sulphate.

Edwin J. Fraser, of San Francisco, patented the conversion of alkali or alkaline-earth metal dioxides into sulphates (barium sulphate being presumably intended), removing the metallic sulphate, and using the solution with cyanide to treat gold ores. This process, or a modification of it, was used for some time in California, but more or less secrecy was observed in the use of the so-called "tickler" of barium peroxide.

Just previously, Martin Waldstein had patented practically the same thing—the use of lead or barium peroxide plus acid, or of hydrogen peroxide, with agitation, in connection with potassium cyanide. Patents were granted at the same time to M. Crawford and associates, one for barium peroxide plus hydrochloric acid, and one for sodium peroxide plus sulphuric acid and water-glass, as additive reagents in cyaniding. In all three cases the idea seems to have been to add only just enough acid to decompose the peroxide.

Some years later two more United States patents were granted for the use of barium peroxide with cyanide, this time to Eugen Schilz, of the Transvaal, and T. B. Joseph, of Salt Lake. The Schilz process was put into actual use, and is said to have increased extraction from 76 up to 89 per cent, the peroxide being sprinkled on the ore during filling and before the addition of solution.

Hydrogen peroxide was claimed in a British patent by W. H. James, a New Zealand patent by Birkin, and in United States patents by Thede and by E. D. Kendall; the last-named used it in conjunction with a thiocyanate. The use of ozone was suggested by Emil Andreoli, who designed ozonizers for charging air.

It is interesting to note that Dr. Bodlaender, of the Aachen Technical High School, found evidence that hydrogen peroxide was actually formed in the first stage of the reaction between gold, potassium cyanide, oxygen and water.

E. D. Kendall obtained a number of patents for oxidizing agents, the most important being for the use of sodium peroxide and of potassium ferricyanide; these were at one time in practical use at several plants in the United States. J. R. Hebaus patented an electrocyanide process in which the use of sodium peroxide was specified, together with other oxidizing agents.

In recent years manganese dioxide was again used in South Africa in the Usher process, in the form of umber or the mineral known as "wad." Others have suggested the mixing of manganese dioxide with ore prior to the addition of an alkaline peroxide in solution.

[1] *Engineering and Mining Journal-Press*, Vol. 115, p. 440, March 10, 1923.

oxygen being liberated from both when they are brought together.

In a general way all of the oxidizing agents mentioned, as well as numerous halogen compounds which have been suggested, seem to have been at first intended to supply oxygen or its equivalent in order to satisfy Elsner's reaction; some, however, were stated specifically to be used for the purpose of oxidizing certain materials in the ore under treatment, which might otherwise absorb such oxygen as was originally present.

Lead, South Dakota. W. J. SHARWOOD.

Platinum Metals and the Jewelry Industry

THE EDITOR:

Sir—The remarkable increase in the use of the so-called platinum metals in the years since the war has brought many new problems to the attention of the commercial laboratories catering to the jewelry industry, and the varying and numerous combinations in which these metals are used in jewelry indicates not only a burning of the midnight oil in a perusal of the literature, but also constant experimental research. The chemist called upon for the first time either to determine the various elements for purposes of sale or to devise means of separating them for refining will have his patience and common sense well tried.

Much has been written about these metals since 1748, and the U. S. Geological Survey has published a bibliography compiled by Dr. James Lewis Howe and H. C. Holtz which has been of incalculable value to those interested in this absorbing and intriguing group of metals. It is hard to say which has been and is the most contradictory, the literature or the metals themselves. It is not generally realized by the layman that an important and extensive industry is behind all the white gold and platinum metal ornaments worn by the people of today, for a study of the annual reports of the U. S. Geological Survey on the platinum metals can hardly give the whole tale, valuable as this compilation is.

The manufacture of platinum jewelry is distributed in the main far more widely than that of gold, there being, we believe, about 250 shops in New York City alone, the latter, with Newark, being the center of this branch of the jeweler's craft.

The unavoidable and the avoidable waste is relatively much greater in such shops, due to the high cost of these metals as compared with silver or even of gold. Together with the dental alloy and solder manufacturers and the dentists, these allied industries have enough scrap, filings, polishings, sweepings, solutions, etc., in turn to support twenty or thirty refiners. Some of these, of course, lead a rather precarious existence, and the number no doubt will be thinned out in the course of the next few years. Many of these refiners act merely as brokers and collectors, accumulating, mixing, and preparing the material so that it may be disposed of at the lowest refining cost to the large smelters in New Jersey. But others of these small buyers and some of the jewelry shops attempt to refine the precious metal, and this has resulted in adding to the confusion now existing as to what is and what is not platinum, and will account in large part for the impure and low-grade metal which is sometimes used.

It is not surprising that such metal should be on the market, for the chemist, well trained as he may be in the analysis and separation of the precious metals, finds the literature a veritable babel of contrasting and conflicting opinions. To select the chaff from the wheat and to know what and what not to believe is a complicated and serious problem which is not at all appreciated by the rank and file, the very simplicity of some of the refining and analytical methods as written acting as the pitfall. Under the present law this impure platinum can be sold, and it is responsible in part for some of the difficulties encountered in the manufacture and sale of platinum articles.

There is no reason why platinum cannot be prepared with a fineness of 990, and even here the difference of 10 parts fineness is equal at this writing to about $1.15 as compared with 100 per cent platinum. When it is realized, then, that one part fineness based on the present market is equivalent to about 11 or 12c., it can be seen that right here the buyer of the low-grade metal has an immediate advantage, provided, of course, that in purchasing the low-grade metal the lower value or cost has been passed on by the seller.

This, however, is but one phase, as platinum or iridium has a specific gravity almost twice that of palladium, for instance, and, of course, more articles of the same size can be made from the poorer grade metal.

No one questions the advisability or necessity of changing the present law, but where a beginning should be made is the problem. If it is desired to fix a minimum degree of purity for those metals in the platinum group, it would seem that either a high degree of fineness should be specified or else no limitation other than the requirement of a guaranteed analysis to accompany the bill of sale should be made. The latter seems to me to be the better practice.

When we come to the manufactured article, however, the problem is complicated by the lack of knowledge on the part of the consumer, in this case the public in general. Fineness or percentage means little or nothing to the ordinary man or woman buying platinum jewelry. I venture to suggest that the situation can be covered in a large measure by applying the law and the legitimate terms now in vogue for gold ware, using the karat value and substituting the word platinum or palladium as the case may be.

It is futile to suppose that the use of palladium could or should be prohibited, and indeed there is no reason to be ashamed of the legitimate application of that metal. There is no doubt that jewelry can be made of it, and it has its own important place in industry. Of course, when its use is perverted and it becomes an adulterant of platinum, as is unfortunately sometimes the case, we have an example not only of unfair competition but of fraud on the public, and the necessity arises of protecting the industry against its own members.

There seems no reason why a ring, for instance, containing 75 per cent of platinum should not be termed 18k. platinum, when custom has made the practice legitimate in the sale of gold articles.

Of course, at present iridium may be considered as platinum for purposes of sale, as, its value being greater, it cannot be classed as nor is it an adulterant. But already it has competitors as a hardener of platinum, and though we hear little of osmium, rhodium, and ruthenium, research with those metals is going steadily on, and the first named is already being used in place of iridium. And who can say, for instance, that there will always be the difference in price between these metals that there is today, or who would

guarantee that iridium, for instance, will always be higher in cost than platinum?

If gold or even some still cheaper metal will give the same satisfaction as a hardener of platinum and otherwise fill the place of iridium, then according to all the laws of economics the cheaper metal should and will replace that member of the group.

Whatever law is enacted should cover the basic principles, but no limitation should be placed that would in any way restrain the legitimate application of a commodity or interfere with the extension of its use.

General prohibition of the use of white gold or palladium is both improbable and undesirable, but it is evident that the honest manufacturer, the retail jeweler, and the ultimate consumer will have to be protected in some way from their masquerading as platinum.

The solving of the questions raised here in connection with jewelry made from solid metal is one thing. To suggest a remedy or answer the questions raised by the combination of white gold and the more precious metals, as by giving a face of platinum or palladium by rolling or flashing, is something else, and is not the least of the problems now crying for a solution. This is not a subject that should concern only the jewelry industry, nor should the settlement of these vexing questions be left to them alone. Their efforts to formulate and have passed a bill or law governing the sale of the precious metals should be upheld.

The present law of New York State which allows a fineness of 925, and under which any of the so-called platinum group are classed as platinum, is obviously out of date and incomplete. THOMAS A. WRIGHT.

New York, N. Y.

Terms of Precision

THE EDITOR:

Sir—While usually agreeing with most of what T. A. Rickard writes, I must say that I don't quite agree with all of his contentions in his article entitled "Terms of Precision" which appeared in the *Journal-Press* of April 7. In the first place, I don't agree that "technical terms are essentially terms of precision," although I agree that they should be, which is the reason for my letter in the March 10 issue criticising the phrase "ore in sight," which, as both Mr. Rickard and the *Journal-Press* rightly admit, is *not* precise; that is, that "ore blocked out" is not really "in sight" after all; therefore, why use the term? Why not use "ore blocked out"?

Mr. Rickard's definition of "ore," while quite plain to the miner, cannot be considered very "precise" either; in fact, on analysis, it is quite misleading to everybody else but the miner, because, if his definition that "ore" is metal-bearing rock that can be exploited to economic advantage were generally accepted, it would lead to hopeless confusion, for the following reasons:

1. Every mine that was not paying dividends would be assumed to be simply a "rock" mine.

2. Under one management a mine would be an "ore" mine, while the same mine, under other management, would be a plain "rock" proposition.

3. If a mining man stood before a cabinet of ore specimens, he would be obliged to class every specimen as plain "rock," unless he had reliable information as to the size, situation, and other details of the property whence the specimen came.

4. Another mining man might come in and stand before the same cabinet, and for the same reason pronounce the specimens which the first man called "ore" to be plain "rock," and those which had been designated as "rock" to be very valuable "ore."

5. The unfortunate layman, sitting near by hearing the dicta of the above Solomons, and who perhaps had some intention of investing in some of the properties whence the specimens had come, would naturally begin to doubt the sanity of the mining game, and would leave mines and miners severely alone thereafter.

6. Others, as well as myself, would be obliged to class a very large deposit of galena ore, which I know of in this country, which averages about 40 per cent lead and 20 oz. silver to the ton, as just "rock," simply because it happens to be about 100 miles from a railroad and only accessible as yet by a pack trail; but if we *did*, I think the majority of people would agree that we were fit candidates for the asylum.

7. Is a large deposit of beautiful marble, for instance, changed into some common, plebeian variety of "rock" simply because it is 100 miles from a railroad? Is it not still "marble," regardless of every other consideration?

8. Is a deposit of auriferous gravel *not auriferous* if it is too poor or too remote to work?

The above reasons (and many more) indicate that Mr. Rickard's definition of the word "ore" is far from "precise," and is, in fact, rather ridiculous—much more so than the term "unpayable ore" which he ridicules. "Unpayable ore" is at least accurate, plain, and brief, and its meaning is obvious to all—namely, mineralized material too poor to work at a profit; but as the word has a rather hopeless sound I would suggest that "non-payable ore" be used instead, as that phrase seems to leave some hope for the future.

As criticism without constructive suggestion is not very helpful, I would with due humility define "ore" as "natural metalliferous material, usually mixed with rock, and always, unless disturbed, contained by rock."

The term "payable ore" seems to cover what Mr. Rickard means by his definition and is accurate, like the term "non-payable ore." Therefore, why not accept it? If not acceptable, I'm afraid Mr. Rickard will have to invent a word to convey his meaning, just as the prospectors up here have invented a term for mineralized material hopelessly low-grade—namely, "dumpite."

Smithers, B. C. DONALD C. SIMPSON.

Utilization of Waste Material

THE EDITOR:

Sir—The publication of the article on the utilization of waste material in the March 17 issue reminds me that I read some years ago that, at the Great Fitzroy mine in Queensland, an office was built of bricks made of slag. Slag from the Great Cobar and Port Kembla smelters, in New South Wales, was used in road building.

At the Mysore gold mine, in India, the residue from the Butters filters was found suitable as a raw material for the manufacture of bricks, assay crucibles, and, possibly, muffles. I believe that some of the tubes used in the refining of bullion by the oxygen process were also made from this material.

In Victoria, Australia, the tailing from sluicing plants operating in the Beechworth district was stacked and leveled for use as farming soil.

At Lithgow, New South Wales, slag from an *iron* blast furnace was spread on the roads, but crumbled to powder. WILLIAM MOTHERWELL.

Los Angeles, Calif.

Abuse of Wire Ropes

A Complex and Intricate Mechanism—Kinds of Misuse—Care in Cutting Rope—Clips Should Be Applied Carefully—Advantages of Large Sheaves—"Overwinding" Bad—Lubrication: by the Maker and by the User

By Henry M. Hall
General Superintendent, George C. Moon Co , Inc.

A WIRE ROPE is a complex and intricate mechanism, the embodiment of much designing skill and careful workmanship. As such, it deserves the care and attention usually bestowed upon a fine and costly machine. Far too often, however, a piece of wire rope is given scarcely more consideration than so much wrapping twine. For this reason, I believe that an enumeration of some of the various ways in which a wire rope is commonly abused and neglected will prove instructive to the wire-rope user, and, perchance, cause him to vouchsafe a little more consideration to this most efficient working tool.

The methods by which a wire rope may be ill treated fall under four general heads, with reference to:

1. Fittings and holding devices
2. Operating devices
3. Lubrication
4. General treatment.

These will be considered in the order enumerated.

Balanced Tension in All Wires

During the course of the manufacture of wire rope, the greatest care is exercised to make certain that the wires in the strands, and the strands in the rope, are so laid together that the tension in each wire and strand is equal to that in every other wire and strand. In a rope so made, each strand and wire will take its full and correct share of the tensile load and of the surface wear to which the working rope is subjected. If for any reason these uniformly distributed initial tensions are disturbed, most of the load and wear will be thrown upon a few of the strands, with the result that the life of the rope will be greatly shortened and its service much impaired.

One of the most common causes for this unbalancing of the load on the strands is carelessness in seizing and cutting the rope preparatory to attaching sockets or thimbles or other attachments. Before cutting the rope, it must be bound, on each side of the cut, securely and adequately, so as to prevent any possible loosening or working back of the strands. Fig. 1 illustrates the proper way of applying these seizings. Eight or ten wraps for each seizing are sufficient—in fact, it is really a waste of time and material to make more—and they should be made with soft annealed iron wire. The size of the tie wire should be proportioned to the diameter of the rope to be bound, the tie wire diameter being from one-tenth to one-fifteenth of the rope diameter, the first factor for small ropes, and the second factor for large ropes.

Effects of Bad Socketing

Too much emphasis cannot be laid on this matter of properly binding and holding the ends of the rope. Fully 90 per cent of all the rope complaints in the oil fields, for instance, are distinctly traceable to defective binding and socketing of the ropes. Fig. 2 shows an oil-well drilling line in which the original uniform

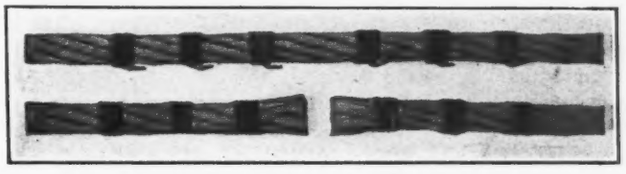


Fig. 1—Proper method of seizing wire rope

tension on the strands was disarranged by careless seizing and socketing. It will be noticed that two of the strands in this line are heavily worn throughout their entire length, although the other strands are in perfect condition. While the rope was being socketed these two strands were allowed to loosen, thus throwing them out of alignment with the others, with the result that most of the wear and abrasion was concentrated on these two strands only. Small wonder that they soon played out, when the burden of six strands was thrust upon them. And, of course, the manufacturer of the rope was roundly "cussed out" for his "bum" rope!

All wire-rope manufacturers furnish complete directions for attaching sockets and other fittings, which

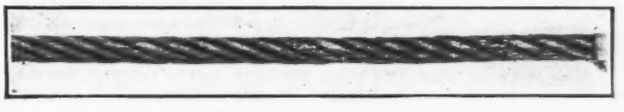


Fig. 2—Wear resulting from faulty seizing and socketing

should be carefully observed and followed. In making any and all attachments, always remember that the cardinal principle is never in any way to allow the rope strands to loosen and thus disarrange the original condition of equally distributed tension and surface alignment. The number of rope failures directly or indirectly caused by the lack of observance of this precaution is almost unbelievable.

Clips Should Be Applied Carefully

Another common mistake is in connection with the use of rope clips, such as the well-known "Crosby" clip. Fig. 3 shows how they are often applied, and Fig. 4 illustrates how they should be applied. Observe the

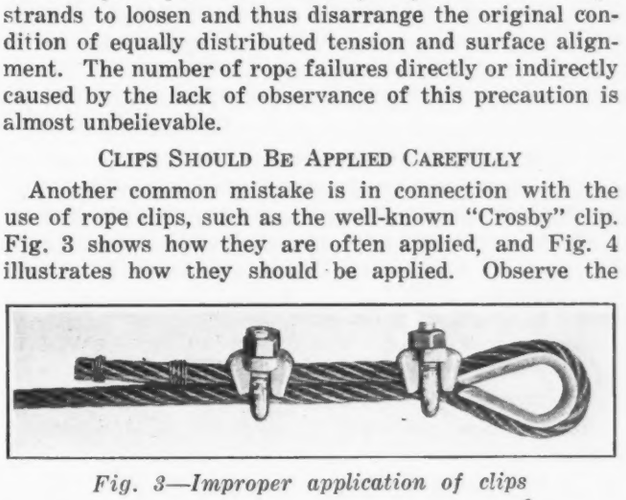


Fig. 3—Improper application of clips

difference. In Fig. 3 the U-bolt part of the clip is bearing on the active side of the eye—that is, that part of the rope which takes the pull. The relatively sharp surface of the U-bolts tends to cut into the rope more or less, distorting the strands and disturbing their uniform arrangement. In extreme cases, these U-bolts may

even nick or cut the wires, thus seriously injuring the rope. In the arrangement shown in Fig. 4 the plate of the clip bears on the active portion of the rope, while the U-bolt is on the dead or loose side. These plates, by virtue of their relatively long bearing surfaces, do not cut into the rope or distort it, and they distribute the clamping pressure over a much greater rope surface.

Size of Drums and Sheaves

In our consideration of the next class of rope abuses, due to the incorrect use or application of operating devices, we come to the question of sheaves and drums, over which the rope runs or is wound. The magnitude of the stresses set up in the wires of a rope by bending it over too small a radius is not generally realized. For example, if a 1-in. 6x19 rope is bent over a sheave 3 ft. in diameter, a stress of nearly 3.75 tons is set up in the metal composing it, before the rope ever pulls a pound; whereas, if the sheave had been 10 ft. in diameter, the corresponding stress due to bending would

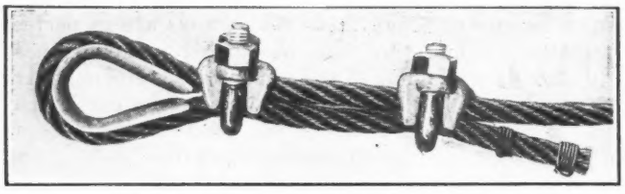


Fig. 4—Proper appplication of slips

have been only 1.125 tons. I well remember the case of a 2-in. 6x37 rope, hoisting a 15-yd. bucket on a large harbor dredge. The head sheave over which this rope operated was only 3 ft. 4 in. in diameter at the base of the groove, thus producing a bending stress of 18 tons in the rope! The live load on this particular rope was about 32 tons, so that 36 per cent of the total load on the rope was that due to bending. Add to this the fact that the groove in the head sheave was too small for a 2-in. rope, being fitted for a 1¾-in. rope, and it is possible to realize the severe punishment this rope was receiving. It often happens that the designer and manufacturer of a rope-using device could, by providing for reasonably large sheaves and drums, instead of excessively small ones, pay for the change several times over by the inreased life and service furnished by the rope. The examples cited above are intended to show that the bending stresses in a rope are by no means negligible, and that, indeed, they may form so large a part of the total load on the rope as to constitute a serious factor in its life and maintenance.

To obtain the best service from the rope, the following table, showing the ratio of sheave diameters to rope diameters for several rope constructions, should be followed as nearly as possible:

Type of Rope	Ratio of Sheave Diameter to Rope Diameter
6x7	70–80
6x19	45–55
6x37	30–40
8x19	30–40
6x42	20–25

For any given type of rope construction, the lowest factor is for the smaller rope, and the largest factor for the larger ropes.

While on the subject of bending, an emphatic warning should be sounded against the reverse bending of ropes. Sharp reverse bending will break up and ruin a rope more rapidly than almost any other abuse to which it may be subjected. The constant flexing of the rope, first in one direction and then in the other, should be avoided if at all possible, especially if the annual cost of rope replacements is heavy. A striking illustration of the effect of reverse bending in shortening the life of a rope is found in connection with the hoisting ropes at the shafts of mines. One of these ropes winds off the top of the hoisting drum, and the other from the bottom of the drum. Thus the underwound rope is subjected to a reverse bend between the drum and the head sheave at the shaft. In view of the large diameters of the drum and the sheave, as well as the considerable distance between them, one would hardly think that this reverse bend would be sharp enough to be serious. Yet the rope records at many mines show the underwound hoisting rope to have an appreciably shorter life than the overwound rope; in some instances as much as 20 per cent shorter.

Size and Shape of Rope Groove

In addition to using drums and sheaves of the proper diameter it is equally essential that the grooves of sheaves and drums, if the drums are grooved, fit the rope properly, without squeezing, crushing, or distorting it. The highly injurious effects of grooves that are too small for a rope are so obvious and become so quickly apparent that it is surprising that there are so many cases of this most elemental form of rope abuse. Rope manufacturers are always ready to specify the size and shape of grooves that are best fitted for any given rope.

Another common practice to be avoided, if possible, is that of allowing a rope to overwind on itself on the winding drum. Often this is unavoidable, where the drum is not large enough to take the necessary length of rope in one layer. The effect of this overwinding is to crush and wear the rope much more than if it were wound in one layer only, with consequent shorter life and poorer service.

Importance of Lubrication

The proper lubrication of a wire rope is a subject upon which a small book could be written. The term "lubrication," as applied to a wire rope, should cover first internal and second external lubrication. Internal lubricant can be properly applied only during the manufacture of the rope. When the individual wires composing the strands of the rope are being twisted to-

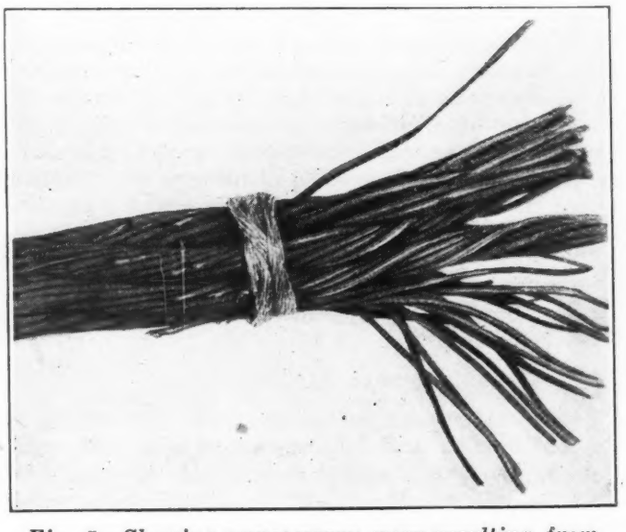


Fig. 5—Showing unnecessary wear resulting from running rope dry

gether, or "laid up," they should be thoroughly and completely covered with a good rope lubricant. Then when the strand is completed, it will be entirely impregnated with the lubricant, with a degree of thoroughness impossible to attain after the strand has been finished. The lubricant thus introduced into the inside of the strand will remain there for the life of the rope, easing and lubricating the wires in their ceaseless sliding and bending over one another, and enabling all the wires to distribute their loads more uniformly than if they were dry and rubbed hard against each other. The following experiments demonstrate conclusively the benefits of this internal strand lubrication. Several lengths of rope were made; in half of them all the strands were dead dry, and in the other half the strands had been thoroughly lubricated, as described above. Thus the two halves of each rope were absolutely identical as to composition and construction, and differed only in the matter of lubrication. Those ropes were then tested to destruction in a tensile machine with the following results:

Size, Inch	Type	Breaking Load, Lb. Dry	Lubricated
⅝	6x19	10,475	10,550
¾	6x19	23,900	25,500
⅞	6x19	47,475	49,500

In another test, the rope was run back and forth over a set of sheaves, the degree of curvature and bending, speed, and load on the rope being the same in both cases. The test was continued until a certain number of broken wires in a given length could be counted. The dry rope failed after 16,000 passages over the sheaves, whereas the lubricated rope stood up for more than 38,000 passages. These two tests are eloquent proof of the wisdom of thorough internal lubrication. And yet I have known of several cases in which rope users insisted upon dry ropes, because a rope properly lubricated at the factory dirtied the men's hands, or got the floors a little greasy! Never mind the increased efficiency and life of a rope; better two or three new ropes a year than a few greasy hands and floors!

Lubrication by the Maker

When the lubricated strands are being closed into the finished rope, the hemp center, about which the strands are laid, should be thoroughly saturated with a good rope lubricant. Not only will this preserve the hemp center against rotting and corrosion, but this lubricant-soaked center will act as a reservoir, to supply the surrounding strands with lubricant, to ease them in their bearing against each other and against the external surfaces with which the rope comes in contact.

The external lubrication of a rope is that which may be done after it has been put to work, to minimize the wear and abrasion as it plays over sheaves, rollers, and drums, and to prevent or lessen rust and corrosion when the rope is exposed to the weather, to salt or acid waters, or to corrosive fumes. The correct and faithful application of external lubricant is entirely in the hands of the rope user, who, in a great many instances, can pay for this attention to and care for his rope many times over by the improved and increased service that the rope will then furnish him. The following is a characteristic example of the beneficial results to be derived from careful external lubrication. At a coal mine a 1⅜-in. rope was used for the water hoist. This rope, without special lubrication, was hoisting between 51,000 and 65,000 tanks of water per rope. After a

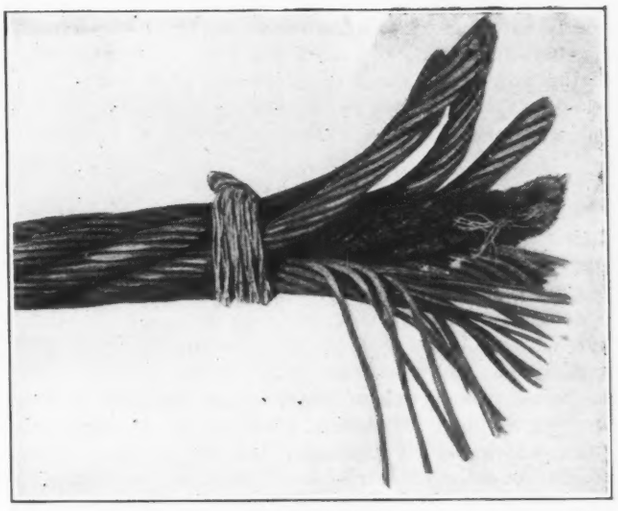


Fig. 6—Showing excellent condition of a properly lubricated rope

rope of the same size and construction had been carefully and continually treated with lubrication, it raised nearly 102,000 tanks of water before it was discarded. Part of the increased life was due to the friction reducing properties of the lubricant, but a large portion of the longer service was the direct result of the protection against rust and corrosion furnished by the lubricant, in the presence of the decidedly acid mine water.

Fig. 5 and Fig. 6 show two oil-well drilling lines, one of which, Fig. 5, was run dry, whereas the other, Fig. 6, was properly lubricated. Notice the hard, brittle appearance of the dry rope and its numerous broken wires; compare with the lubricated rope, which performed much more work than the other, and yet has a clean, healthily worn but live appearance. Oil-well drilling is just about as strenuous service as a wire rope can be called upon to withstand, but when it is compelled to work dry, in addition to all its other troubles, no wonder it soon gives up. The dry law was not intended to apply to wire ropes!

Care in Attaching Ropes

Coming now to the last group of abuses, there are a number of general ways in which a rope may be ill treated. Oftentimes nails are driven through the end of the rope to hold it to the reel or drum on which it is wound or to be wound. If this is done, it is inevitable that the strands of the rope will be more or less displaced and forced apart. This will consequently disarrange the original adjustment of the strands, which disarrangement we have already found to be undesirable. The rope ends should be fastened to the reels by means of loops of seizing wire, served to the rope.

Occasionally, especially in the case of large ropes, four or five of the strands are cut back from the end for two feet or so, leaving one or two projecting strands, to form a loop or handle to facilitate holding the end of the rope while it is being pulled off from the reel. This practice, by throwing considerable strain upon one or two strands only, causes the rope to twist or rotate about these strands as a center, thus loosening them and again disturbing the initial adjustment. If a handle for holding the rope end is required, a served loop should be provided, as described above.

One of the A.B.C.'s of rope treatment is the avoidance of kinking. The evils resulting from kinking are so generally known and admitted that it is really surprising how many cases of kinks one still finds. Reasonable care in handling, installing, and operating a rope will make impossible the occurrence of kinks.

Sudden Strains Should Be Avoided

Recently, there came to my attention an occurrence which is deserving of mention in discussing various forms of rope abuses. A large derrick was erected on the fourteenth or fifteenth floor of an office building under construction, and was held in place by three guys, which in turn were fastened to girders or columns by slings of ⅞-in. plow-steel rope. While a large boiler was being raised, one of these slings snapped in two, throwing sudden, unbalanced stresses on the other two slings, which parted also, allowing the derrick to fall and do considerable damage—fortunately without injury to anyone. Investigation showed that the full breaking load of each sling, amounting to about twenty-six tons, if applied slowly, would not break the sling nearly so cleanly as it was broken in this accident. This shows conclusively that there must have been set up a series of sudden and pronounced jerks. The amount of energy represented by a sudden jerk of this kind may be tremendous—much more than sufficient to snap a large rope like a cotton thread. It therefore behooves the rope user to exercise the greatest care in avoiding sudden jerks, such as may be occasioned by the quick application of dynamic loads, or the rhythmic and cumulative swaying of static loads.

Frequently a wire rope costs more than an automobile —why not, then, give it care and attention at least approximately in keeping with its value? No working tool will respond more quickly and thoroughly to good treatment—and to ill-treatment as well—than a wire rope.

Mining and Milling Costs of the Belmont Surf Inlet Mines

Thanks to the thoroughness with which the financial reports of the Tonopah Belmont Development Co. are made, costs of operation of the Belmont Surf Inlet Mines, a subsidiary organization operating in British Columbia, are available for 1922.

There were mined and milled 105,971 dry tons of ore, of an average value of $8.76 per ton and a gross value of $928,964.26, compared with 134,570 dry tons, of an average value of $6.89 per ton and a gross value of $927,162.24, in the previous year. Net Surf Inlet operating profits were $117,849.61 in 1922, an increase of 107 per cent over the similar profits—$56,966.43—of 1921.

The average metal content of the 105,971 dry tons of ore milled was 0.375 oz. of gold, 0.189 oz of silver, and 6.578 lb. (0.329 per cent) of copper, and the gross metal contents were 39,785.62 oz. of gold, 20,073 oz. of silver, and 697,058 lb. of copper.

Concentrate production totaled 9,614,171 dry tons, containing 34,916.15 oz. of gold, 17,063.52 oz. of silver, and 695,196 lb. of copper. Concentrates amounting to 28.23 dry tons and containing 88.78 oz. of gold, 42.33 oz. of silver, and 1,862 lb. of copper were added to absorptions. The total recovery of concentrates was 9,642.39 dry tons, containing 35,014.93 oz. of gold, 17,105.85 oz. of silver, and 697,058 lb. of copper, the gross value of this tonnage being $828,329.05 and the average value being $85.90 per ton. The recovery of metals by concentration was 88.01 per cent of the gold, 85.21 per cent of the silver, and 100 per cent (nominal) of the copper. The recovery was 89.36 per cent of the money value. The ratio of concentration was 11.02 into 1.

Direct mining costs were $3.695 per ton, of which $2.436 per ton was for stoping and $1.159 per ton for development, compared with $2.246 for stoping and $0.945 for development in the previous year. Direct milling costs were $0.922 per ton and flotation royalties were $0.097 per ton, compared with $0.85 per ton and $0.075 per ton, respectively, in the previous year. Island freight costs were $0.159 per ton, or less by $0.007 per ton than in the year previous. General expense (administration, taxes, office, insurance, and legal) were $0.44 per ton, compared with $0.374 per ton in the previous period. The total operating costs were $5.213 per ton in 1922, compared with the 1921 similar costs of $4.69 per ton. Of the advance of $0.523 per ton over the cost of the previous year, $0.214 per ton is accounted for by the larger expenditure, proportionate to tonnage, for development work. Stoping costs were higher by $0.19 per ton than similar costs of the previous year, because of more difficult mining conditions. Milling costs and flotation royalties were higher because of a lesser tonnage of higher-grade ore treated.

Improvement in Development Costs

The per-foot costs of development were considerably lower than in the previous year, because of bettered efficiencies and improved methods.

The average per-foot cost of drifting was $12.972, of the crosscutting $12.971, of the raising $16.534; lower by $2.056 per foot for the drifts, by $2.321 per foot for the crosscuts, and by $1.786 per foot for the raises than the per-foot costs of the previous year.

The mill operated without interruption throughout the year. The ball mills ran for 12,794 hours, or for 73.4 per cent of the possible time, the time having been governed by the supply of ore from the mine.

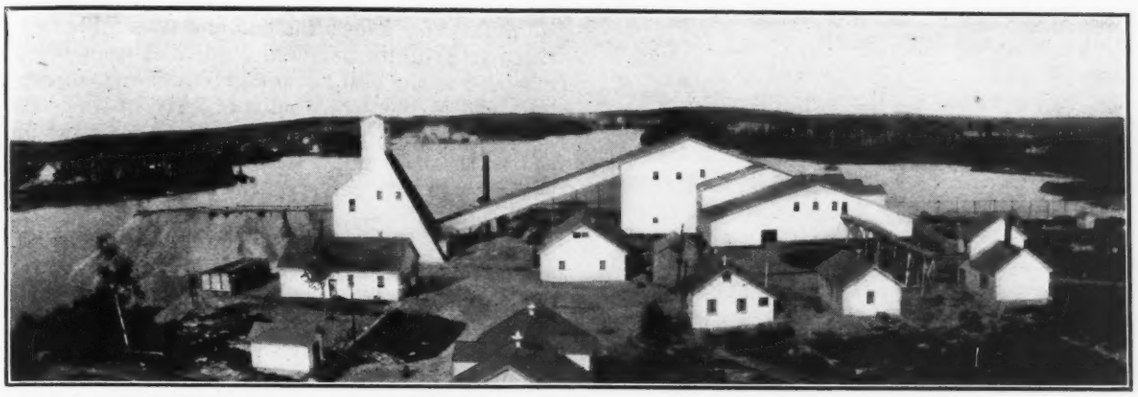
The concentrates produced during the year totaled 9,642.39 dry tons (of which 28.22 tons was added to absorptions), with metal contents as shown above. The ratio of concentration was 11.02 into 1. The somewhat lower ratio of concentration as compared with the year previous—11.89 into 1—was due to the heavy copper-bearing sulphide ores treated.

Metal recoveries by concentration were practically identical with those of the previous year. With the higher grade ore milled, as compared with the ore of the previous year, the recoveries should have been higher, but a still greater proportion of refractory ore was milled, and no better recoveries could be achieved.

Milling costs per ton, as compared with similar costs of previous years, were as follows:

	1922	1921	1920	1919
Labor	$0.327	$0.300	$0.405	$0.3794
Supplies	.527	.493	.632	.7639
Power	.068	.057	.074	.0839
Direct milling	.922	.850	1.111	1.2272
Indirect milling	.170	.154	.222	.2200
Flotation royalties	.097	.075	.115	.1250
Total milling	1.189	1.079	1.448	1.5722

The costs are slightly higher than those of the previous year, but, as the labor costs are affected inversely as the tonnage milled, and as supplies costs are affected by tonnage milled and by the grade of the ore, the 1922 costs are creditable.



General view of surface plant looking west across Kirkland Lake

The Wright-Hargreaves Cyanide Mill

Recently Constructed 200-ton Plant in the Kirkland Lake District of Ontario Considered a Model—Straight Cyanidation Used for Treating $12 Ore—Special Air Agitators Used in Thickeners

BY J. E. GRANT
Mill Superintendent, Wright-Hargreaves Mines, Ltd.

THE CYANIDE PLANT of the Wright-Hargreaves Mines, Ltd., at Kirkland Lake, Ontario, is generally considered by metallurgists who have visited it to be one of the model plants of its kind on the continent. It was originally built for a capacity of about 175 tons per day, but no difficulty has been found in putting through considerably over 200 tons. Compared with the reduction plants at the gold mines further north in the Porcupine district, it is therefore of small proportions, but a description should prove no less interesting on that account, for more men are directly interested in mills of this size than in those whose daily capacities run into the thousands of tons.

The Wright-Hargreaves mine is probably the most favorably situated deposit in the Kirkland Lake district, being on the main ore-bearing fracture near the center of the productive area. The ore occurs in a red feldspar-porphyry accompanied by quartz and syenite and associated with bands of conglomerate and lamprophyre. The veins at Kirkland Lake have been said greatly to resemble, in their mineral constituents, those of the Sierra Nevada, in California. The following summary of a description given by A. G. Burrows and P. E. Hopkins, Report of the Ontario Department of Mines, Vol. 29, Part 4, is of interest:

The oldest mineral in the veins, apart from the rock-forming minerals, is a coarsely crystalline quartz. Usually this quartz has been broken up and other minerals have been deposited in the fracture planes, including a darker-colored quartz, and carbonates. Sericite and chlorite also occur in the veins. Pyrite is the most abundant of the sulphides, being found both in the wall rock and in the veins, usually in well crystallized forms, though some is in fine grains. Chalcopyrite occurs to some extent, where the gold is present. Galena and sphalerite occur in small quantity, but molybdenite has been deposited abundantly in fractures, usually as a thin film. Graphite has also been recognized.

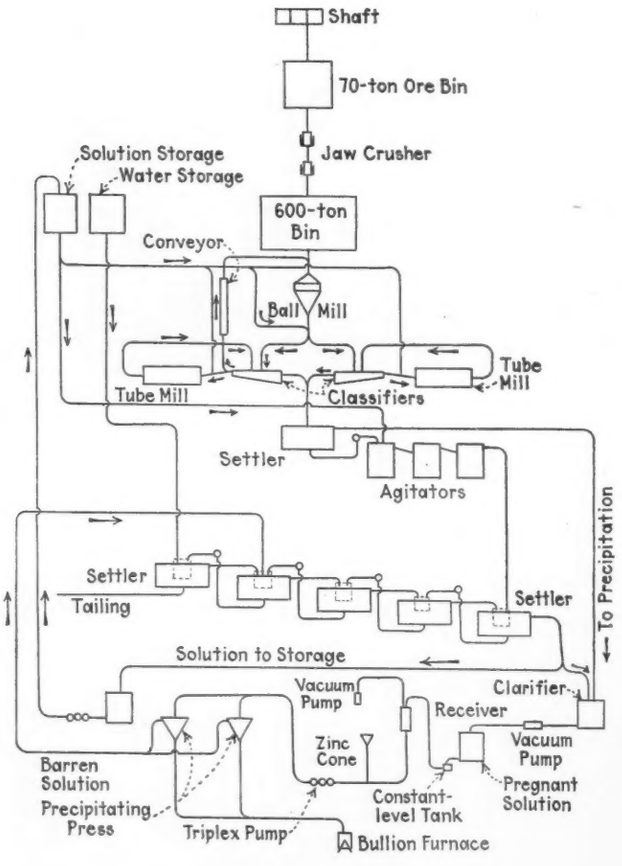
Gold-bearing solutions have circulated along slip planes, and the veins have been enriched by the deposition of gold in these later fractures. Later movements have often occurred along these planes, and the gold, altaite, and other tellurides, pyrite, chalcopyrite, molybdenite, and graphite deposited along the planes have been crushed and polished or slickensided. Several tellurides have been recognized, the most abundant being altaite, PbTe. This mineral is readily recognized by the well-developed cubical cleavage and brilliant cleavage planes. It has a faint greenish tinge. It is usually accompanied by visible gold, and its presence often indicates high-grade portions of the vein. The other tellurides that have been reported as found in minute quantities in various mines of the district include calaverite, $AuTe_2$, kalgoorlite, coloradoite, tetradymite, and hessite.

The milling ore at the Wright-Hargreaves, during 1922, averaged about $12 in gold per ton.

BLAKE CRUSHERS USED ON THE MINE ORE

The flow sheet is well illustrated in the accompanying diagram. The ore is delivered from the mine on to a 12x16-in. grizzly over a 70-ton inclined-bottom ore bin, and is fed from the bottom of the bin, by a 24-in. rubber belt conveyor, to a 24x12-in. Allis-Chalmers Blake crusher. The discharge from the crusher is elevated by a 14x7-in. bucket elevator over a bar grizzly to a secondary Blake crusher of the same size as the primary machine. In the secondary crusher, however, a cast steel spacing block is used to close the crusher opening to 24x8 in. The discharge falls on an 18-in. belt conveyor, which carries it to the mill bin.

The belt feeder which feeds the primary Blake crusher is driven by a belt from tight and loose pulleys on a countershaft geared to run about 15 ft. per min. The upkeep is low, the rubber belt that was originally installed still being in use after twenty months' wear. The crusherman stands at the belt, where he works his levers and picks out any scrap iron or wood that he may see. Both crushers are placed on the same level as the repair floor, with a crawl and I-beam overhead



Flow sheet of mill

serving both crushers. The drive is from a 50-hp. motor to a countershaft, one crusher being run off a solid pulley, and the other one from a clutch pulley to make starting easy. All drives are underneath and may be oiled from the working floor, so that the crusherman has no need to be near dangerous belts. This is an important feature from the safety standpoint, as only one man is employed in crushing, working on a nine-hour shift. The advantage of having all machines handled from one floor makes it convenient for the crusherman to watch everything, which partly offsets the cost of elevating between crushers in a plant of this size.

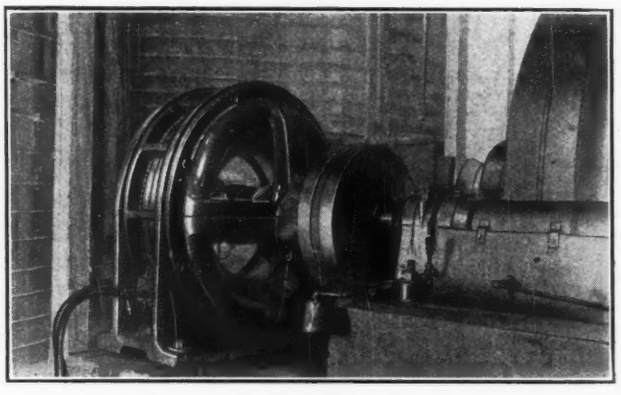
Fine-Grinding Equipment

The flat-bottomed ore bin which supplies the fine-grinding department has a capacity of 600 tons, but only about half of this is available without shoveling. A belt feeder draws the ore from either one of two chutes in the bottom of the bin to an 8-ft.x30-in. Hardinge ball mill, the feeder being capable of adjustment to any speed required. A revolution counter operated off the pulley shaft registers the travel of the belt, and twice each shift one lineal foot of ore is taken off the belt and weighed, the weight varying as much as 8 lb., according to the character of the ore. This method of estimating the mill tonnage of course is not accurate, but in the long run checks well with the mine figures.

The ball mill discharges into two 4-ft. 6-in.x19-ft. Dorr classifiers in closed circuit with two 5x16-ft. Allis-Chalmers ball-pebble mills. The coarse product from one of the classifiers may be diverted to a 10-in. belt conveyor, which returns the oversize to the feed of the ball mill. This allows the ball and tube mills to be kept with a constantly balanced load, and each machine is thus used to the best advantage. A change of ore sometimes causes the pebble mills and classifiers to be overloaded, and it is then necessary to cut down the primary feed to the ball mill. Without the return of oversize, the balls will then pound on the lining, causing excessive wear.

Balls 5½ in. in diameter and weighing 27 lb. are used in the ball mill. Larger balls may be used, but smaller ones result in decreased capacity. The mill runs at 19½ r.p.m., which may be increased easily to 22. The higher figure was the speed that was used when the mill began operations, but it was too fast for the tonnage handled, and excessive wear to the liners resulted. The mill is loaded until it rejects the balls. Manganese steel linings are used. The peripheral liners last approximately 150 days (milling 200 tons a day). Chilled cast-iron liners will last from 60 to 70 days. A 12 -hp. motor connected with a 16-in.x4-ply and a 10-in.x4-ply Rider rubber belt supplies the power. When running at 19½ r.p.m., the mill consumes about 110 hp.

The tube mills were originally loaded with flint pebbles and had El Oro liners, but the maximum capac-



Tube-mill drive

ity of the two mills was only 125 to 150 tons per twenty-four hours, 60 per cent of which passed a 200-mesh screen. The flint pebbles were then replaced with 1¼-in. cast-iron balls without change of speed or linings. This resulted in grinding 200 to 260 tons, 80 to 85 per cent of which passed a 200-mesh screen. With flint pebbles, the mills were loaded well above the center and consumed 70 to 75 hp., whereas with the cast-iron balls the load is around 20,000 lb., added so as to keep the horsepower constant at 90 to 100, as shown by the ammeter. The mills are direct-connected through a herringbone gear and flexible coupling, as shown in the illustration, to a 100-hp. rotor-wound motor, and run at 28 r.p.m.

The balls now used are flattened, as may be seen from a careful inspection of the photograph. Although the makers claim an advantage in grinding from this shape, it is my own idea that casting them in this form permits the ball to shrink to better advantage in cooling, permitting a denser and harder center. The center of any ball is more or less spongy, and crumples when the ball is worn.

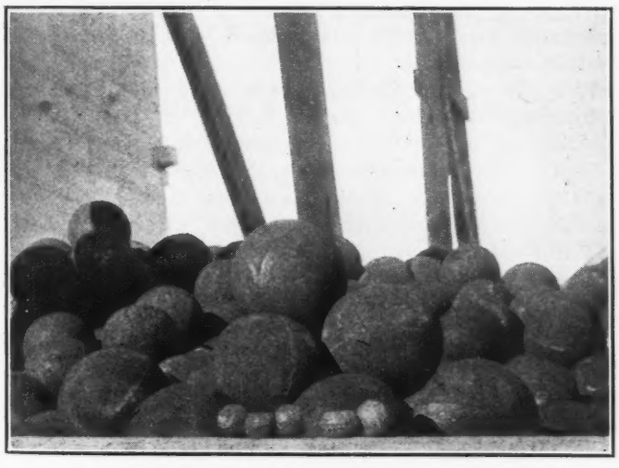
The overflow from the classifiers is elevated in either of two 7x12-in. bucket elevators which discharge into a cone classifier. The oversize returns to the tube-mill feed, and the overflow goes to a primary or No. 1 thick-

ener, 33x10 ft., from which the gold solution is decanted off for precipitation. The pulp is pumped from the bottom of the primary thickener to three 16x20-ft. Dorr agitators in series and on the same level, the last agitator discharging about 1 ft. below the top. The pulp agitated contains about 60 to 65 per cent water and is kept constant with storage solution. Agitation continues for about thirty hours. The pulp from the agitator goes to the first thickener of the decantation plant, where it meets the overflow solution from No. 3 thickener and is mixed in a small air agitator within the thickener. These air agitators, shown in an accompanying drawing, are a special feature of the decantation, and were designed because it was found that the ore had a tendency to form in a pasty or gluey mass in the thickener. This did not disintegrate readily and caused trouble in two ways.

Reasons for Air Agitation in Thickeners

In the first place, this sticky mass would form on the rakes and around the shaft, increasing in size until it would become heavy and stop the thickener. Then it would be necessary to raise the rakes through this mass of slime from one to two feet before starting again. The load was so heavy that it sometimes bent the rakes, causing endless trouble. To avoid this, constant watching is necessary, and the man on each shift examines and reports the condition of his rakes. As soon as the pulp begins to build up, he either lifts the rakes or breaks the mass down with a pole kept for that purpose.

Secondly, it was noticed that the mill tailing carried too much gold in solution, and on tests being made it was found that, owing to the character of the ore, the



Type of small and large balls used

pulp and solution did not readily mix at the point in the center of the thickener where washing was supposed to take place. The small agitator, or mixer, as shown, was then designed to overcome this poor washing, an arrangement so satisfactory that one was put in each thickener. The agitator in the last thickener is arranged so that the solution from the thickener, together with the water, can be added before discharging to waste. A somewhat improved solution of the gold is also accomplished, which makes the tailing noticeably lower.

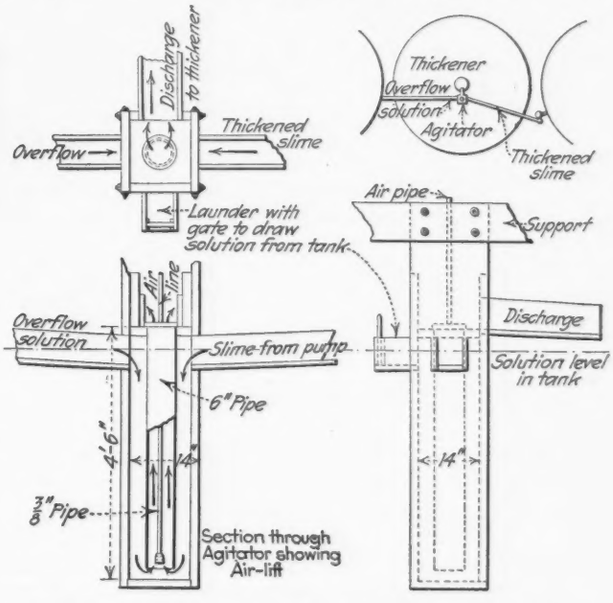
The decantation unit consists of five tanks in series, with one foot difference in elevation between each tank. It is desirable to keep the tanks on as near the same level as possible and yet get sufficient fall for the launders, for the smaller the lift on the pump the thicker the pulp may be pumped, and the longer the diaphragms will last. The pumps used are of the McIntyre type, with 4-in. diaphragms. The speed is varied by a three-step cone pulley. These pumps have a straight vertical lift, making the work easier on the diaphragms than the reciprocating motion used on some pumps. The capacity of the pump is 200 to 225 tons per twenty-four hours, running on the middle speed of 24 r.p.m. The tailing discharge has a moisture content of about 50 per cent, or one ton of water to the ton of ore.

The solution which is decanted off the primary Dorr thickener is sent to a clarifier with twenty 5x7-ft. leaves, only ten of which are in use at a time.

The same vacuum pump which draws the solution through the leaves lifts the solution to a gold storage tank on the second floor, from which it passes to a constant-level tank. It is then syphoned into the vacuum tank of the Crowe system, then pumped, with the addition of zinc dust, to a Merrill press. The pump is driven by a Reeves variable-speed transmission, which also drives the zinc feeder. A glass tube shows the level of solution in the gold-storage tank, and any variation in the solution to be treated is taken care of by the operator who adjusts the variable-speed transmission. A revolution counter attached to the solution pump is used for measuring the solution, the pounds per revolution being estimated from the number of revolutions required to decrease the level of solution in the tank one foot. This is determined each shift.

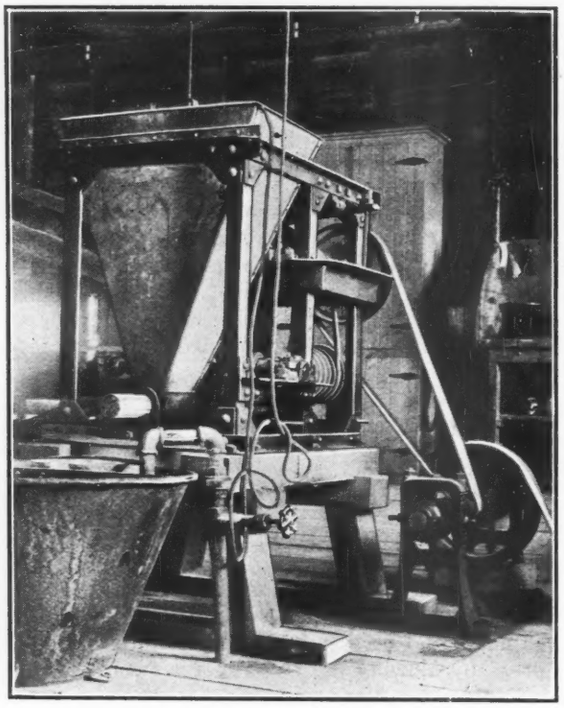
Less than one-half ounce of zinc is required to precipitate a ton of solution. No lead acetate is used, as it was not found necessary. The precipitate is dried in the press by blowing air through for twelve to sixteen hours. The precipitate so dried goes direct to a tilting furnace, no acid treatment being used. From each melt is obtained a high-grade matte, which is run down with iron in the last melt, the bullion running from $15 to $16.90 per oz. in gold and silver. The average recovery is about 93 per cent, the slime tailing running 40 to 90c., varying with tonnage and grade of ore.

For several weeks after the plant was placed in operation the bullion results checked closely with what would



Agitator for mixing thickened slime and overflow solution before rethickening

be expected from the various assays. As time went on, however, the bullion results became higher than they should be from the assays. Different methods of solution assays were then tried and checked with each other, including fluxing the lead sponge from the lead acetate with the ordinary fluxes in a clay crucible before cupellation. It was discovered that a loss equal to as high as



Zinc feeder

5 per cent of the gold in a ton of solution was caused by the direct cupellation of the lead sponge. This volatilization loss may be due to the tellurium in the ore. Flue dust from the assay furnace was also assayed and showed a high gold content.

Costs of Installation and Operation

The mill was erected during 1919, when labor and material were at their peak. Costs were as follows:

Mill building	$47,364
Mill machinery	101,106
Crusher-house building	5,963
Crusher-house machinery	7,512
Total	$161,945

An analysis of operating costs for the year 1922, for the whole property, may also be of interest:

	Cost per Ton Milled
Mine development and exploration	$1.301
Stoping	1.404
Transporting ore (hoisting)	0.475
Milling	1.611
Marketing bullion	0.059
Administration and management	0.540
Miscellaneous expenses	0.348
	$5.738
Depreciation of plant and equipment	0.579
Total	$6.317

During that year, 66,181 tons of ore was treated, and bullion worth $762,752 recovered, or $11.52 per ton treated. The mill operated 88.3 per cent of its possible running time, being shut down 2.4 per cent for repairs, and 9.3 per cent for lack of power, chiefly in October, when forest fires made it necessary to suspend operations entirely for thirty days.

Two characteristic examples of the daily mill reports are shown below:

	Sept. 19, 1922	Jan. 8, 1923	
Assays: Mill feed	$9.97	$12.40 (Actual)	$10.44 (Calculated)
Mill tailing	83c.		84c.
Gold solution	$4.23		$3.81
Barren solution	1c.		1c.
Solution precipitated, tons	533		546
Value per ton	$4.22		$3.80
Total value	$2,249.26		$2,074.80
Ore milled, tons	253		216
Running time	24 hours	23 hours, 52 minutes	
Value of ore milled	$2,459.25	$2,678.40 (Actual)	$2,256.24 (Calculated)
Solution values, storage	$2.27		$1.32
Agitator No. 1	5.29		6.57
No. 2	5.79		6.94
No. 3	6.32		6.78
Thickener No. 1	4.50		5.79
No. 2	2.31		2.89
No. 3	0.68		0.78
No. 4	0.25		0.27
No. 5	0.06		0.08
No. 6	0.04		0.07
Press tailing (grab)	....		Trace

Remarks: The cause of delay was the time consumed in tightening ball-mill bolts.

Owing to the favorable development of the mine, it has recently been decided to increase the capacity of the mill to between 400 and 500 tons, doubling the present equipment. This construction work will be started immediately, and the enlarged mill is expected to be in operation late in 1923.

U. S. Platinum Production Unchanged in 1922

Nearly a thousand ounces of platinum, valued at more than $100,000, was produced in the United States, not including Alaska, in 1922, according to the U. S. Geological Survey. Placer deposits in California and Oregon yielded in 1922 a total of 929 troy oz. of crude platinum and osmiridium, valued at $101,000. This output compares favorably with that in 1921, which was 977 oz., in view of the unfavorable water conditions that prevailed throughout most of 1922 in the Klamath Mountains of northern California and southwestern Oregon. In California, crude platinum was produced in 1922 in Amador, Butte, Calaveras, Humboldt, Sacramento, Shasta, and Trinity counties, the county which led in production being Shasta County. In all, 516 oz. of osmiridium and 360 oz. of platinum were recovered, of which 352 oz. of platinum and 24 oz. of osmiridium were the output of dredges at the base of the Sierras. In Oregon, crude platinum was recovered by placer mines in Coos, Curry, and Josephine counties in 1922, the total output reported to the Survey being 51 oz. of platinum and 2 oz. of osmiridium.

Ontario Mica Sales Include Much Scrap

Although the total tonnage of mica marketed by producers in Ontario in 1922 greatly exceeded that of 1921 or 1920, the proportion of scrap was large. Rough-cobbed mica sold totaled 86 tons, worth $21,955; thumb-trimmed, 24 tons, valued at $13,294, and scrap, 2,119 tons, worth $21,231. Owing to the occasional nature of sales to dealers, trimmers, and splitters, and to resales, it is difficult to keep an accurate record of operations. Prices for thumb-trimmed mica, depending on quality, ranged as follows:

Size	Price per Lb.	Size	Price per Lb.
1 x 1 in.	7c. to 22c.	2 x 3 in.	40c.
1 x 2 in.	20c. to 30 c.	2 x 4 in.	60c.
1 x 3 in.	25c. to 30c.	3 x 5 in.	$1.50

Scrap mica at about $10 per ton was fairly uniform in price, according to the Minister of Mines.

The Marketing of Selenium and Tellurium

Byproduct Metals That Have Limited Uses —Sold in Highly Pure Form as Powder or Sticks—Market in a Process of Evolution

By F. F. Colcord
U. S. Smelting, Refining & Mining Co.

THE SUBJECT of this article might well be prefaced by some remarks on the development of the selenium and tellurium industry. The earliest production of selenium seems to have been made by the sulphuric acid manufacturers, who recovered selenium from sludge in connection with their processes. The amount of selenium recovered was small. Germany reported a production of selenium in 1910 of about 1,650 lb., valued at about $3.50 per lb. The copper refineries in the United States found that the anode slimes in their process contained appreciable quantities of selenium and tellurium, and about 1905 began efforts to recover this selenium and tellurium, and some production and sales of selenium were made between that date and 1910. The tellurium produced evidently found no market.

In 1910 the output of selenium was reported for the United States as 10,674 lb., with prices ranging from $3 to $5 per lb. A somewhat larger production was made during the succeeding two years, with slightly lower prices prevailing. The first marked increase in production of selenium took place in 1913, with an output of 29,097 lb., and with prices from $1.60 to $1.75 per lb. In the same year it is recorded that a small amount of tellurium was produced and shipped to Europe. The next noteworthy increase in the production of selenium was in 1917, with 39,630 lb., with prices ranging from $1.29 to $2 per lb. The selenium figures for 1918, 1919, 1920, and 1921 are interesting, showing a production of 103,694 lb., 60,025 lb., 92,141 lb., and 59,807 lb. respectively. The price range during these four years was from $1.60 to $3 per lb. During 1919 imports of selenium were valued at $25,866, and may have represented reimportations of domestic selenium which had previously been bought at low prices. It will be seen that the selenium industry has outgrown its swaddling clothes, but should still be considered an infant. The production of tellurium during these years continued to be small, with a nominal price of $3 per lb.

Selenium Used in Glass Manufacture

One of the earliest efforts to use selenium was in the preparation of so-called "selenium cells" in connection with telegraphic and cable communication, the electrical conductivity of selenium being affected by light. Probably the first use of selenium in commercial quantities was in the manufacture of red or orange-colored glass, and red enamel ware, and for some time this was the principal use of selenium in the United States. The later and larger use for selenium has been in the so-called "decolorizing of glass," whereby selenium incorporated in the molten glass bath offsets the green color due to the presence of iron. For many years the glass industry in the United States used high-grade manganese dioxide imported from the eastern Mediterranean districts. After 1914, when imports of high-grade manganese dioxide were difficult, the glass manufacturers were obliged to turn to selenium as a decolorizer, and the demand in this direction was the reason for the increased production in later years. It is probable that the use of selenium for this purpose was developed in Germany. It is also true that from 1910 on, England and the Continent were buyers of selenium, and undoubtedly used it in the decolorizing of glass. Tellurium, on the other hand, has only been used within the last few years, and only in small quantities, its principal use at present being in radio work, where, in combination with a crystal of zincite, it is used in the detector. This industry has afforded a modest consumption of tellurium, but not enough to really put production on a commercial basis.

Demand Uncertain

Another use for tellurium has been in the silver industry, but here, again, the demand is extremely small. Messrs. Thomas Midgley, Jr., and Thomas Boyd, of the General Motors Research Corporation, have found that an addition of a minute quantity of di-ethyl telluride to gasoline, together with higher compressions, greatly increases the efficiency of a gasoline engine. The amount of tellurium, however, which could be produced is at present insufficient to treat all of the gasoline used in the United States, which would have to be done if the use of the element in this application is to be put to practical account.

It can readily be understood that since the main use for selenium is in the glass industry, the consumption in the United States is confined to the glass-producing states, such as Ohio, West Virginia, Pennsylvania, New Jersey, and New York; while abroad, England, Germany, France, and Czechoslovakia are consumers.

The annual consumption of selenium is somewhat hard to estimate, because production is irregular and therefore production figures do not give an index of consumption; but if the production for the last four years be averaged, it is reasonable to assume that the figure so obtained, 79,000 lb., would represent the annual consumption in this country and part of the European consumption. The demand is also irregular and does not follow the seasons.

Selenium and tellurium are usually sold as being 99 per cent pure, and are not sold generally under brand names, the reputation of the producer being sufficient to guarantee the quality of the product. The domestic selenium is fully equal to if not better than foreign selenium. Selenium is mostly sold in the form of powder (amorphous condition). Selenium powder is of a fineness that it will practically all pass an 80-mesh screen. A small quantity is marketed in stick form. The selenium powder is put up in cans containing fifteen and twenty-five pounds and packed in wooden boxes containing four or eight cans. Shipments are made either by freight or express, as the needs of the case may be. Tellurium is marketed in the form of slabs and sticks. Selenium and tellurium are sold in lots of 100 lb. or multiples thereof. Sales are on a flat price,

without premiums or penalties, and upon the seller's weights and statement of purity.

The production of selenium in the United States, since 1910 at least, has been almost entirely confined to the electrolytic copper refineries, and the same applies to tellurium, with the exception that it has been produced at lead refineries also. In consequence of the sources of production, the marketing of selenium and tellurium is handled through the New York offices of the various producers, the principal ones being the American Metal Co., the American Smelting & Refining Co., the United Metals Selling Co., (Anaconda) New York, and the United States Smelting, Refining & Mining Co. The price is based upon the weight of the material and not upon the actual contents of selenium or tellurium. The usual terms of settlement are cash on arrival, but in some cases thirty days' credit is allowed. There are not any special marketing problems in connection with these metals and the price is based on supply and demand. The fluctuations in price have been indicated earlier in the article, the quotation at present being $2 to $2.25 per lb. for lots of one hundred pounds or more, for both selenium and tellurium. The average price over a period of years possesses little significance, as the industry is in a process of evolution. It would be hard to forecast future prices from prices that have prevailed in the past, except that it is probably not profitable to produce selenium or tellurium at a figure much lower than $2 per lb. In general the domestic market is not likely to be influenced by importations; in fact, the normal condition of the industry would be one where a certain amount of exports regularly took place.

Gold Precipitation at the Brakpan

The following description of the gold-precipitation plant at the Brakpan Mines, in South Africa, has been prepared by B. J. Hastings and appeared in a recent number of the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa. The Brakpan is one of the few mines on the Rand using zinc dust for purposes of gold precipitation since the beginning of milling operations in June, 1911.

The precipitation plant at Brakpan Mines is equipped with three Rumsey three-throw pumps, delivering at a maximum rate of 43.7 tons of solution per pump per hour, at the present rate of ram speed, each delivering to a Merrill press of forty units. This solution tonnage is equivalent to 3.150 tons per day, though the solution actually precipitated varies with the tonnage milled, being normally about 1.25 tons of solution per ton of ore milled, or one ton of solution per Merrill press unit per hour.

Since the introduction of the Crowe vacuum process of de-aëration of solutions, the zinc-dust consumption has been reduced to about 30 per cent of the amount used before the installation, varying at present between 0.04 lb. and 0.05 lb. per ton of ore treated. Experience at Brakpan indicates that with this feed of zinc dust, precipitation is equally effective with solutions having a range of strength of 0.009 per cent KCN to 0.03 per cent KCN, solutions at this mine lying within these limits, the average value of filtrates giving 0.03 dwt. per ton by assay. The zinc feed totals 70 lb. per press for the first twenty-four hours after starting up, after which 29 lb. per day is sufficient, assuming a tonnage of forty-three tons of solution going through the press per hour. It appears necessary to maintain a high degree of alkalinity in the solutions, anything below 0.018 CaO having a tendency to increase filtrate values. The introduction of lead nitrate in steady and sufficient quantities also appears to exercise a strong influence in obtaining efficient precipitation, the consumption at Brakpan averaging 0.035 lb. per ton of ore treated over the last few months.

Smelting operations have benefited in respect of cost and labor. Acid treatment of the zinc-gold slime from the Merrill press continues, the resulting slime being calcined and pot smelted, producing a bullion of just over 800 fine. This bullion would be considerably finer were it not for its lead content. The calcined slime is of a higher grade, returning over 5 oz. of fine gold per pound of slime, or containing roughly 35 per cent of gold.

Mining in Northern Rhodesia

Northern Rhodesia has possibilities that are worth investigating by prospectors, according to a correspondent. It possesses few good roads and is greatly in need of better transportation facilities. The Bwana M'Kubwa copper mine, after a life of many ups and downs, has been recapitalized on the strength of a successful series of experiments made with the ore by Minerals Separation. Construction work is now going on under the direction of Percy K. Horner, formerly with the Union Minière du Haut Katanga, who has recently been appointed consulting engineer. The Kansanshi copper property, owned by the Rhodesian-Katanga Junction Railways & Mining Co., had just built a new concentrator and smelter when the war broke out and stopped all operations. At the Broken Hill mine, which is worked principally for lead and vanadium, there has been talk of turning to profit the zinc that occurs in the ore.

The Jessie gold mine, the only one in the country, is worked on a small scale by its owner, J. Cowie. The Allies copper property is a prospect situated near the farming center, Lusaka. It is under option to London capitalists, who are pushing development. Bismuthite is produced by the Bismuthite mine, near Lusaka. Like many other mines, it has cost the owners more than it has ever produced. The Sable Antelope and the Silver King mines are 120 miles west of Broken Hill, a point on the Bulawayo-Congo Railway.

Cost of Copper Production of the Tennessee Copper Co.

It cost 13.337c. per lb. to produce copper in 1922 by the Tennessee Copper Co., according to the annual report of that company. During the year 287,499 tons of Tennessee Copper ore was treated, which yielded 7,538,942 lb. of fine copper, the extraction being 26.2225 lb. of copper per ton of ore treated. In addition to the above, 14,339 lb. of fine copper was recovered from scrap, making the total production 7,553,281 lb. of fine copper.

The total cost per ton of ore was $3.35458, equal to 13.337c. per pound of fine copper, subdivided as follows:

Mining expense	$.05440
Railway expense	.00208
Treatment expense (smelting and milling)	.04217
Converter expense	.01283
General expense	.02189
Total operating costs per pound of fine copper from Tennessee ores (exclusive of New York charges)	$.13337

Mining in Old Japan

The Bronze and Iron Ages—Methods of Recovering Gold and Silver—The Reduction of Lead Ores

By H. H. Manchester

MOST OF THE ARTS were introduced in Japan by the Buddhists from China. These first entered the Island Kingdom about 289 A.D., but did not become strong there until the middle of the sixth century. They did much to introduce not only metallurgy but silk, the manufacture of paper, medicine, and astronomy.

Chronologically the first metal to be considered in Japan would be copper. When the Japanese settled in the islands, perhaps seven centuries before the Christian era, they brought with them bronze swords and arrow heads. These were found in the earliest dolmens, or burial mounds, before the introduction of any weapons of iron. Such bronze swords are very rare and valuable, and few analyses of their metal have been made, but these indicate that the bronze consisted of copper and tin without any purposeful addition of lead, zinc, or other metal. These weapons were cast, but just how the ingredients were then produced or melted is uncertain.

The Bronze Age in Japan extended to about 100 B.C., when it was followed by the Iron Age. It had been discovered that steel made a better sword than bronze, but bronze was still used alongside of steel for part of the arrow heads, bells, and mirrors, and, in preference to iron, for objects of art.

Buddhism, which was successfully introduced in Japan in 552 A.D. and became the state religion about 600 A.D., brought in a knowledge of art forms, and did much to encourage the production of bronze objects, which in turn made a greater demand for copper. It also led to a more careful consideration of metallurgy and of various mixtures for bronze.

The first copper coin produced in Japan is said to date from 708 A.D., and was no doubt suggested by Chinese coins which had some circulation in the islands.

In the case of copper mining there is a rather good description of how the Japanese carried on the work before modern methods were introduced: Wherever possible the Japanese miner located the chief entrance to his mine well up the side of a mountain or hill, and dug at a moderate slope, though of course following the lode wherever it led. Vertical shafts were not used as an entrance, though if the mine were long they might be constructed as air shafts. Sometimes in small mines they were omitted entirely, with the result that the air in the mine would scarcely support life.

The methods employed for removing the water, which was a constant menace to the mine, were tedious and ineffective. Besides bamboo pumps there were small treadwheels run by the workmen. In some cases a hundred men were employed merely to keep down the water in the mine, and, even with this expenditure of human labor, the water often rendered the mine useless.

The lamp commonly used by the early Japanese miner was merely a shell or small dish filled with oil, and a wick made of the pith from a rush. With the aid of this he made his way down the declines to where he was to work. Besides a chisel and hammer, his principal tool was a sort of double cutlass. Most of the ore was extracted in small pieces. In carrying the ore to the surface, a straw or bamboo basket which held about 80 lb. was employed. This was either carried on the back of a helper, or was dragged along the various inclines by a straw rope which was fastened around the waist of a workman, or even of a woman or child.

Opening a mine, from an early Japanese print

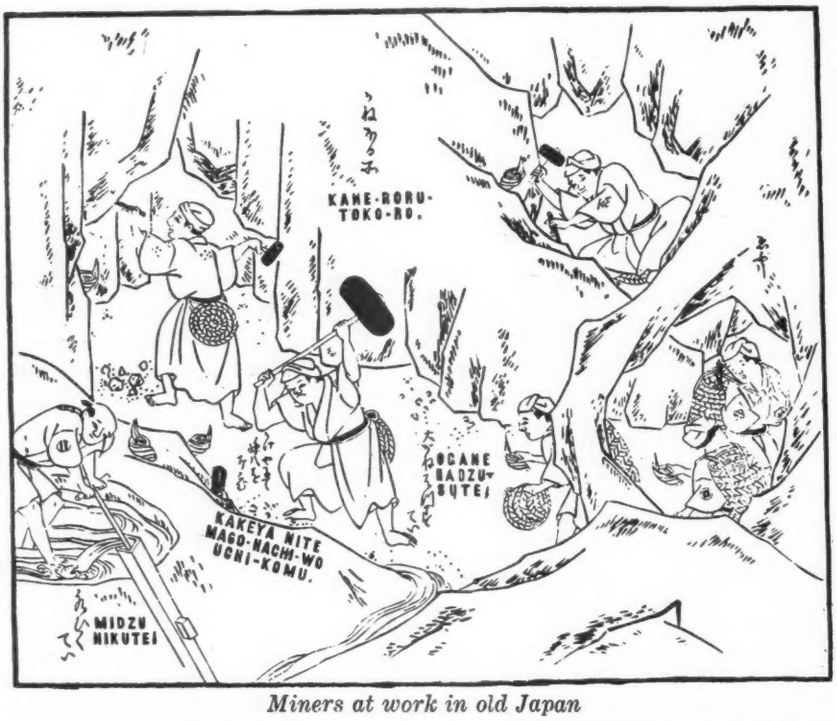
Before smelting, the ore was cleaned and separated from other stones by women and children. It was then roasted in a furnace, which was in some places merely a hole in the ground, and, in others, a sort of kiln. The roasted ore was pulverized and smelted to produce a blister copper. In early days the Japanese did not understand smelting well enough to purify this product further at the mines, and it was sent to the government refinery at Osaka for treatment. In general the processes employed were somewhat as follows:

The ore was roasted or calcined to expel part of the sulphur, arsenic, or other content, and pounded to produce the black powder. It was then fused with silicate to remove the oxide of iron formed in roasting and con-

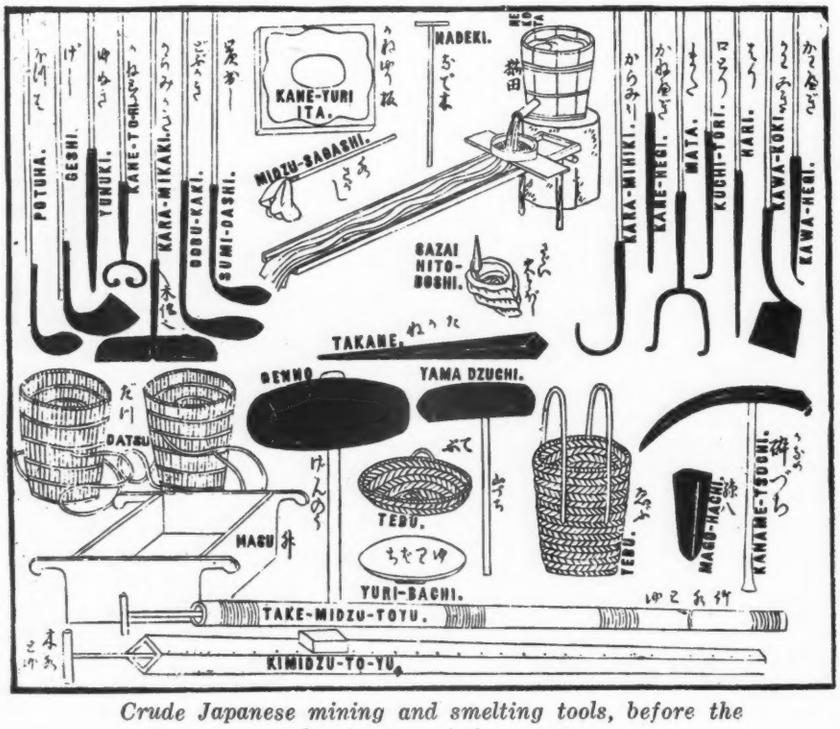
vert the oxide of copper into copper sulphide and finally coarse metal. This metal was again calcined to remove sulphide of iron and silver, producing crude copper. This was once more refined to purify the copper and make it tough, the product being a melted copper bar of commercial fineness.

The Iron Age, as we have noted, began in probably the first century of the Christian era, as iron relics are found in dolmens dating from about that period. One legend credits the forging of the first iron sword to Tui-Shiki just before the Christian era. Iron was used for swords, and was also hardened into steel for the same purpose at a not much later date. Wrought iron was employed for armor, horse trappings, spear heads, and the like.

It is remarkable that many of the best iron weapons and other products were plated with copper, which in turn was coated with gold or silver. This, of course, was not only for the sake of ornament, but to prevent rust. The old Japanese method of smelting iron, in use through the medieval period, was somewhat as follows: The furnace was a trough, of various lengths, of clay. The sides rose in the shape of a V, and were also of clay, and there were holes near the bottom for the blast. This trough was charged with alternate layers of charcoal and ore, and then burned for perhaps two days and a night, by which time the clay sides were pretty well fused or corroded. The end walls were then broken down, and the fire was raked out, whereupon masses of wrought iron and steel were left sticking to the sides of the walls. These were removed by rods and bars, and broken up or wrought.



Miners at work in old Japan



Crude Japanese mining and smelting tools, before the modernization of the country

Thus every smelting required a new furnace. The product, however, was remarkably pure, and was the material for the famous swords and armor found in the dolmens. It will be noted that in all the earliest smelting of iron the metal was not melted, but merely fused into a lump which was worked over and over by the smith.

How early cast iron was known in Japan is uncertain, but there is said to be a decree of 700 A.D. restricting the casting of iron coins to the government mint. This date is much earlier than the revival of iron casting in Europe, though it will be remembered that it was known both to the Egyptians and to the ancient Greeks.

In smelting the iron, the ore was first piled in heaps with charcoal near the mines, and roasted. This roasted ore was then placed in a cylindrical furnace, which was made of a few stones and much clay applied in layers. The bottom was round, with openings on different sides for bellows, as well as another opening that was stopped with clay until after the iron was melted. This furnace was filled with charcoal, calcined ore, and a little feldspar, quartz, or clay. The bellows were of the Chinese type, worked by the feet of four or five laborers, and the heat produced was sufficient to reduce the iron to a liquid, which was run out into sand forms.

Gold and silver were both known to the Chinese in very early times, but in Japan the earliest record of the discovery of silver seems to have been 667 A.D., and that of gold 749 A.D., though copper and lead were both known earlier.

A series of interesting pictures by a Japanese artist

Preparing ashes for cupeling argentiferous lead

made before the modernization of Japan gives a splendid ideas of the old methods in vogue.

After signs of gold were discovered, a festival day was fixed for the opening of the mine. The ninth day of the seventh month was considered the most propitious of all, and was awaited if not too distant. A temporary shrine was erected, and a priest asked blessings of the gods on the new enterprise, after which the miners and villagers were amused by wrestling matches and other entertainments.

A storehouse and an office were erected, from which the miners received their supplies, and their pay either in money or such necessities of daily life as rice, dried fish, oil, salt, and charcoal or other fuel. This was necessary, for even in Japan the mine was often at an inconvenient distance from the sources of supply.

Another preliminary was the building of a forge or blacksmith shop for making the necessary mining implements and utensils and keeping them in repair. A small foundry was likewise constructed for melting the metal into bars and cakes.

The chief officer of the mine then laid down the directions for the principal gallery. The sides and ceilings were supported by wooden beams, and the gallery itself was made as square as possible, and only slightly inclined. If the entrance were long, air shafts were constructed and reservoirs dug out for the removal of water.

In removing the water, pumps were used which raised it from one level to another. There is also a Japanese picture of about 1600 showing the screw of Archimedes being employed for the purpose. Nevertheless, the Japanese had a great deal of trouble with water in mines, which were occasionally abandoned on this account. The tools of the miners were entirely of the hand variety, and all ore was removed on the backs of assistants.

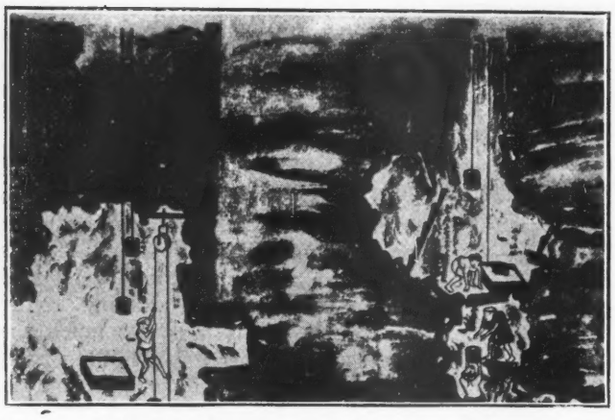
When the ore had been brought to the surface it was given over to women, who crushed it roughly with long hammers, after which it was ground in a circular stone grist mill turned by workmen walking round and round. This mill was much the same as that used for hulling rice. It could be turned by an ass, but in the old days this was unusual.

The ore was then placed in a reservoir and the water run over a wooden plane, to which most of the gold stuck, while the sand was carried along with it. This water was caught in another reservoir, where most of the remaining gold sank to the bottom. This residue was carefully panned in a large wooden tub, the pan used for the purpose being merely a slightly hollowed board.

In medieval times the gold washers received no wages, but were paid by the gold dust which stuck to their clothes. It is stated that "even nuggets were sometimes found in their clothes," which, under the economic arrangement, we are not surprised at. After being washed, the gold dust was blown to separate from it the iron sand.

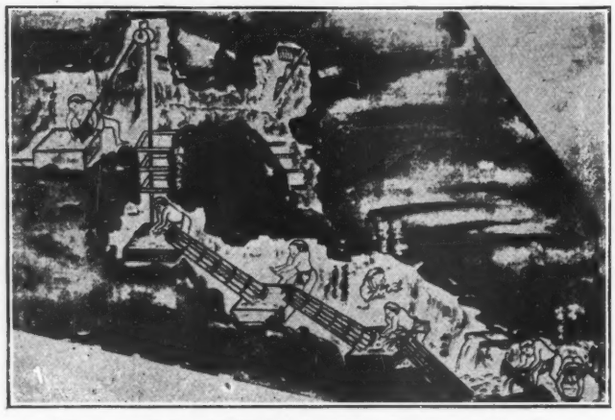
The metallurgical treatment of gold was very crude. The gold dust was heated with salt and ashes over a strong charcoal fire until the gold became fused, after which it was hammered into the desired shape. In medieval times the Japanese had no good way of separating gold and silver, and as a consequence their gold

Washing gold ore on mats in early Japan



Raising water in a Japanese gold mine, about 1600 A.D.

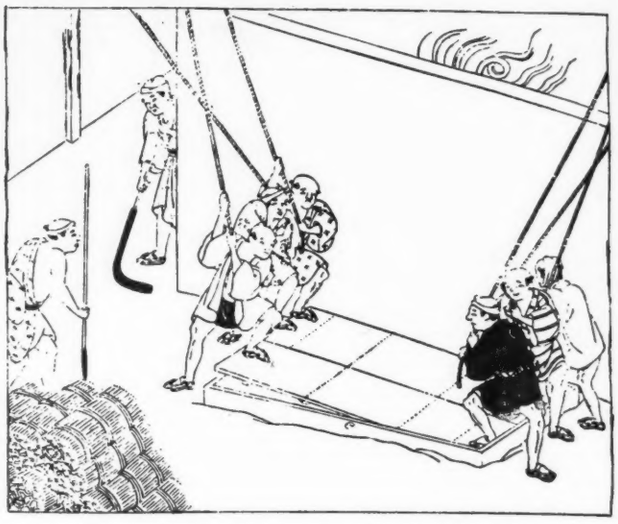
Removing copper disks from smelting furnace



Screws of Archimedes in a Japanese gold mine, about 1600 A.D.

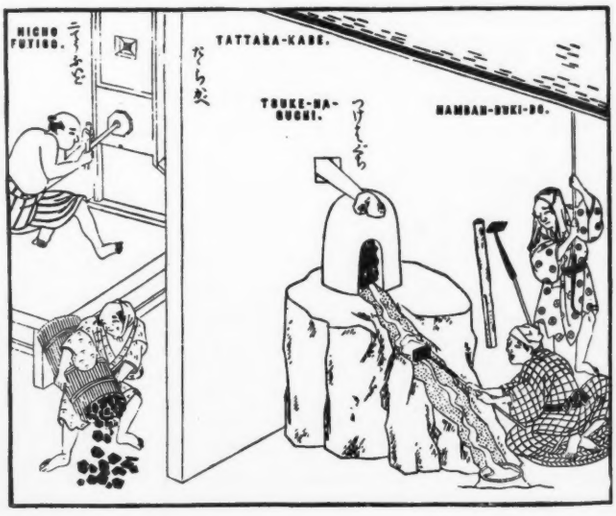
frequently contained a considerable percentage of silver.

According to the known records, silver ore was first discovered in Japan while digging the foundations for a new castle in 667 A.D., and this was smelted into silver about seven years later. It became comparatively common in Japan, and remained so until well into the seventeenth century.



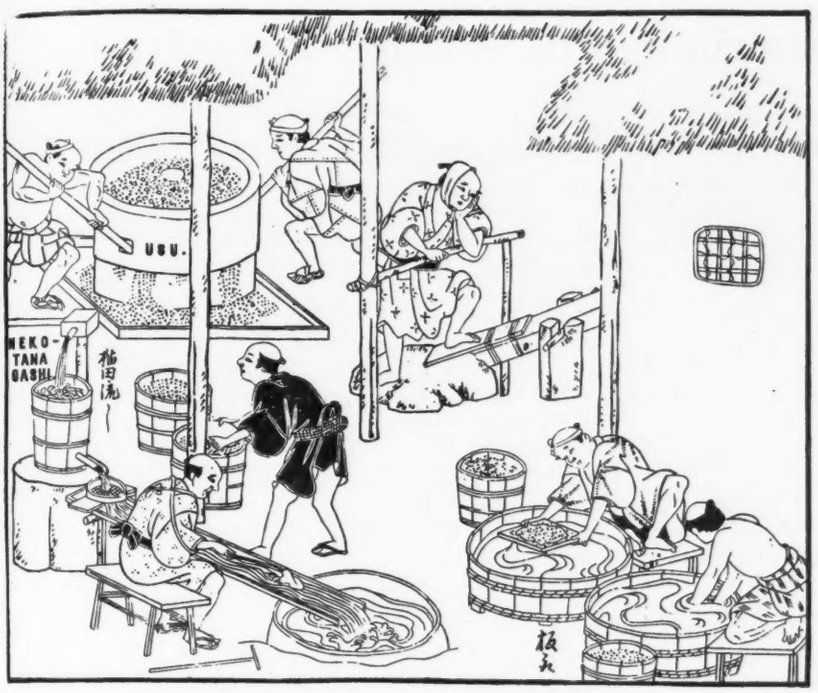
Medieval Japanese bellows used for a blast furnace

At first the Japanese seem to have merely heated the silver ore to extract the silver, but this was successful only in the treatment of rich ores, and by the end of the Middle Ages they had learned to add lead to the ore. Their method of proceeding then was as follows: The metal, possibly copper containing silver, was mixed with lead and heated in a rude liquation furnace to carry off the melted silver and lead, the copper and less fusible metals remaining as porous masses. The mixed lead and



Early Japanese liquation process of extracting silver and gold with the aid of lead

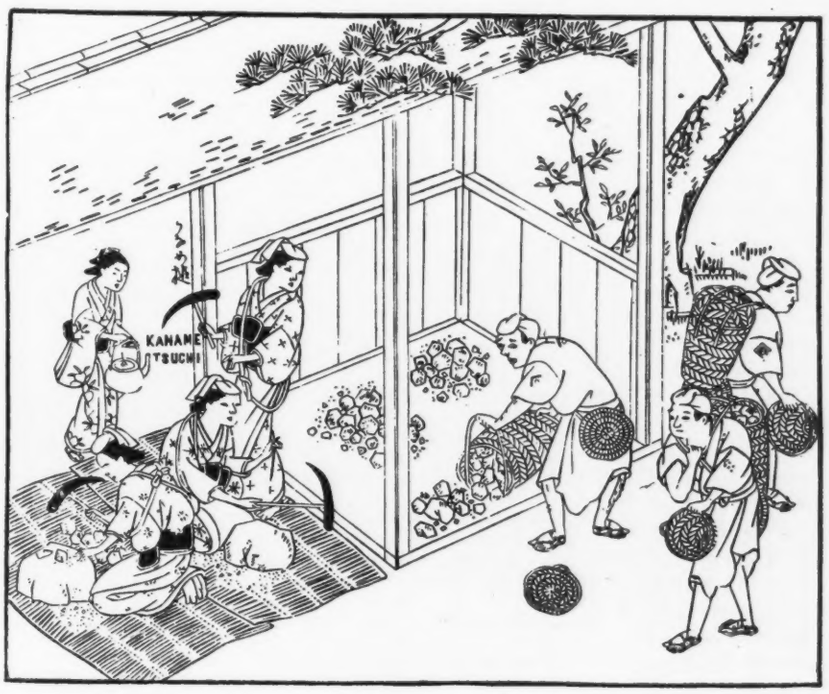
silver were heated in cups in a low furnace with a bottom of ashes to obtain the silver. This was purified by a second cupellation in a small furnace. This method of refining may have been introduced by the Portuguese about 1590. There is a legend that a foreigner named Haku-Sin taught a Japanese called Sumitomo how to



Pulverizing and washing gold ore

separate silver from lead and copper even when the percentage was low. Sumitomo introduced the process into his refining shop, and, rising to wealth, obtained imperial rights for the method. He lived in Osaka, and took the name of the foreigner, in addition to his own, out of gratitude for the secret.

Silver seems to have been reasonably abundant in Japan from 1400 until after the arrival of the Portuguese and Dutch. They gathered in and sent back to Europe so much of the metal that it became scarce, and, in 1671, the Japanese Government issued a decree forbidding the export of silver in any form.



Cobbing gold ore

In the old days the Japanese knew little of the finer methods of desilvering, nor the processes of amalgamation with mercury which performed so important a function in the smelting works of Mexico and Peru.

Even where the lead was found in the form of galena, the old Japanese were still able to reduce it. The ore was coarsely powdered and then placed in a furnace. The interior of this, which was globular in form, was covered with a layer of fine clay. The bottom of the furnace was cone-shaped, so that the smelted metal would collect there. Two bellows were employed to blow the fire, and were inserted into opposite sides of the furnace. In this first operation the fuel used was merely wood.

The first burning produced some metallic lead and some sulphate and oxide of lead, leaving a part of the galena practically unaltered. Another smelting was therefore done with wood as fuel, and still another by means of charcoal, so that a product sufficiently pure was obtained.

The old Japanese also knew how to recover the lead in smelting silver ores by smelting the litharge resulting from the combination of the lead with the ashes that were used in refining.

Guniting in South Africa

Some interesting work has been done with the cement-gun at the plant of the New State Areas, Ltd., on the Rand, South Africa. At this plant concrete tanks set in the ground are to be used, and to transfer the solution tunnels are necessary underneath the tanks for the pipes and conveyors. As soon as these tunnels were cut it was found that even with the slight amount of moisture that there is in that climate in winter the ground would swell. To prevent this the walls of these tunnels were coated with about 1 in. of gunite applied directly to the ground without reinforcement. The ground consists of decomposed rock with layers of sand, and it was this sand which gave the greatest difficulty. This work has been standing now for several months and has given no trouble, notwithstanding the lack of reinforcement. The engineer in charge of the work has been much surprised at the adhesion of the gunite to the ground, as there is one place where there is an excavation about 40 ft. deep where he had one or two slips as a result of swelling. To stop these he gunited the entire face, which was about 50 ft. long by 40 ft. high at the highest point. Since the gunite was applied there has been no further trouble.

Preliminary Descriptions of Mining Prospects

Written Information Supplied by Owners Usually Vague—A List of Queries That Should Elicit Data on Which to Decide For or Against an Examination

BY EZRA E. ERICH
788 Mills Building, San Francisco, Calif.

Ezra E. Erich

THE preliminary information usually presented by the owner regarding a mining prospect in advance of its examination is generally vague. The description usually conveys little pertinent information and the engineer has difficulty in determining whether an examination is warranted. Even reports by engineers are often inadequate. The engineer examining a prospect may be capable and may make careful observations, but he often fails to include sufficient information in his report to make it possible for any one unfamiliar with his personality and with the property to get an idea of its economic possibilities. In some reports the engineer includes elaborate discussions, but fails to realize what information is important. For example, one report recently submitted to me gave an accurate description of the rocks existing in the property, but failed to establish the use of any of them as guides to ore. Another report expressed an opinion that the silver ore of the property had been secondarily enriched, but failed to define the degree of certainty of the conclusions reached. Another report discussed the property in detail, but failed to give the width of the vein or its known length.

The prospector is usually a close observer of certain kinds of details and knows his property thoroughly, but it is seldom that he is able or cares to express his observations clearly in writing. He would much rather show you his property and explain his ideas and reasons for the existence of each working. The mine owner, or agent, is usually vague and superlative in the description of his property. It is seldom that information from either of them is of importance. This is illustrated in an extreme way by the following quotation:

"Regarding our mines, will say that they are the best property I know of today, and it would be hard to pay too much for them, and let me inform you that the supply of ore is inexhaustible. This is the biggest thing in the way of a mine that I have ever had my feet on, and I have examined mines in all parts of the world. Nature has done more in the way of development than could have been accomplished with a million dollars under the most conservative management. I consider it a million-dollar proposition without sticking a pick in it."

Publications aid in supplying general information regarding districts, but their main interest is too often geology itself rather than the discovery of ore. They tell little about size and grade, and for various reasons the information contained in them is often limited and scattered.

Conversations or interviews with interested parties or with engineers who have examined a particular property may give enough information on which either to reject the property or decide on an examination.

Letters from prospectors and mine owners accompanied by brief descriptions of particular properties are almost invariably inadequate.

No rule can be made as to what information should be included in the preliminary description of a mining prospect. However, numerous questions regarding the details of the average prospect aid in obtaining useful information. With this in mind, a series of questions has been compiled and printed on a form. This form is submitted to those desiring to have their properties considered and is intended to aid the prospector and mine owner in giving information regarding his property with as little effort on his part and as much attention to pertinent details as is possible.

Of course many of the questions may be inappropriate to a particular mining prospect, and some of them cannot be answered. Often where the one answering the questions knows little regarding his property the answers are of small avail except to betray his lack of information. In general, however, I find that sufficient information is included by those who fill out the form to base a decision as to the next step.

The following tabulation gives verbatim all of the questions asked on the printed form. On it appropriate space is allowed for filling in the answers so that an eight-page pamphlet of letterhead size tells the salient features of the story.

File No.....

Description of Mining Property

Note.—This blank form has been compiled to aid you in giving us information regarding your mining property with as little effort on your part as possible. If you will fill out this form in detail, we shall be glad to carefully consider the information you submit. In case you are unable to answer questions accurately please say so definitely.

Date.....

1. *Name of Group or Property:*.....
   A. Any other name by which property may be known...
2. *Location and Transportation Conditions:*
   A. Country..... State ..... County.....
   B. Mining district .....
   C. Name of nearest town and distance thereto.....
   D. Nearest railroad and shipping point and distance thereto .....
   E. Directions for reaching property from nearest railroad station or town.....
   F. Is property reached by wagon road?.....trail?.....
      or auto road?.....
      (State condition of each).....
   G. Does wagon or auto road extend to workings?.....
      If not, what distance from mine?.....
   H. What accommodations are at property?.....
      If none, state nearest place where accommodations may be secured.....
   I. Is property in a Forest Reserve?.....

3. *Ownership:*
   - A. Name and address of controlling interests or individuals and share held by each.....
   - B. Name and address (postal and telegraph) of owner's agent authorized to show property.....
     Name and address of superintendent or caretaker on property .....
     If no superintendent or caretaker, give name and address of someone who can show property.....
   - C. Form of title (lode, placer, or agricultural claim)....
   - D. Is property patented?.....
   - E. To what date has assessment work been done and recorded? .....
   - F. Do owners guarantee title?.....
   - G. Describe briefly any lien, encumbrance or litigation against the property.....

4. *Property:*
   - A. Total number of full size claims and fractions.....
   - B. Approximate total acreage.....
   - C. Length claimed along vein or lode.....
   - D. Is property operating or idle?.....
   - E. If operating, on what scale?.....

5. *History of Property:*
   - A. Who first located the property? (give date).....
   - B. What work was done?.....
   - C. To whom was property transferred or optioned? (give dates) .....
   - D. Why or for what consideration was property transferred? .....
   - E. Continue history by giving a brief description to date of various transfers or ownership, reasons for transfer and work done by each new owner.....

6. *Production:*
   - A. Total production and average assay value.....
   - B. Tonnage of ore milled (state location of mill, assay value and average recovery).....
   - C. Tonnage of ore shipped (state where ore was shipped, assay value and average recovery).....
   - D. Tonnage of ore on dump and assay value.....
   - E. Tonnage of ore in stopes and assay value.....

7. *Development:*
   (Enclose maps of property, otherwise draw or sketch the development on last page. Show by plan or section the relation of the development to ore. Give scale and directions and label all workings.)
   In each of the following items state extent to which workings are accessible:
   - A. Number of open cuts on deposit (give size).....
   - B. Shafts on deposit (give names, location and depth of each) .....
   - C. Other shafts near property (give name, location and depth of each).....
   - D. Drifts on deposit, stating levels and length.....
   - E. Crosscuts, number and total footage.....
   - F. Winzes, number and total footage.....
   - G. Raises, number and total footage.....
   - H. Amount of ore blocked out.....
     1. 4 sides exposed.....tons.....assay
     2. 3 sides exposed.....tons.....assay
     3. 2 sides exposed.....tons.....assay
     4. 1 side exposed.....tons.....assay
   - I. Length of oreshoot proved.....
   - J. Average width of ore in vein or deposit.....

8. *Topography:*
   - A. Elevation of claims above sea level.....
   - B. Is topography rugged, steep, rolling or flat?.....
   - C. How much of property is soil or wash covered?.....
   - D. Average depth of soil or wash.....
   - E. Useful vegetation .....
   - F. Source and distance of mine timber.....
   - G. Source and distance of fuel.....
   - H. Source and distance of power.....
   - I. Source and distance of water.....
     1. For domestic purposes.....
     2. For mining purposes.....
     3. For milling purposes.....
   - J. Annual rainfall
   - K. Annual snowfall.....
   - L. Describe climate.....

9. *General Geology:*
   - A. General character of country rock (state whether slate, porphyry, limestone, etc.).....
   - B. Character of deposit, state whether vein, zone, disseminated, contact deposit, placer, etc. (Give a brief description of your idea of the deposit, stating width and length) .....
   - C. What rock composes hanging wall?.....
   - D. What rock composes footwall?.....
   - E. Character of dikes, if any (give size).....

10. *Ore Geology:*
    - A. Predominant mineral or metal of commercial value contained in vein or lode (gold, silver, copper, etc.) .....
    - B. Number of workable veins or lodes.....
    - C. Known length of vein or lode on surface or extent of area if disseminated (describe each).....
    - D. Average width of veins or lodes (describe each).....
      (If widths are not known give estimated width).....
    - E. Dip of vein or lode (whether flat or steep).....
    - F. Strike of vein or lode.....
    - G. Principal ore and gangue minerals.....
    - H. Is ore oxidized or sulphide? .....
      Name all the minerals you can identify.....
    - I. General character of croppings.....
      size.....occurrence (frequently or occasionally) .....any quartz?..... copper?..... amount?.....
      (names of copper minerals).....
      generally distributed .....or in spots.....
      Are sulphides anywhere in croppings?.....
      Any altered rock?.....(Decomposed rock?) .....gypsum?.....
      Of what are croppings composed? (gossan, quartz, etc.) .....
      From what derived.....
      Per cent of sulphide in croppings.....
      Give horizontal dimensions of mineralized area.....
      Does area described grade into barren rock at limits? .....or are limits determined by soil cover? .....by capping? .....or other material? .....(give depth of each).....
      Continuity proved (give distance or area).....
      Probable continuity where covered (give distance or area) .....
    - J. Oxidation.
      Depth .....depth of leaching.....
      Is leaching complete? .....or incomplete?.....
      Oxidation products .....
      Quantity of mixed oxide and sulphide ore.....
    - K. Enrichment.
      Describe in detail if any secondary enrichment, giving depth, thickness and area.....

12. *Character of Ore in Detail:*
    - A. Grade, assay values of high-grade ore (Au Ag Cu, etc.) .....
      Assay values of average-grade ore (Au Ag Cu, etc.) .....
      (Where possible include analyses of other metals or minerals) .....
      Copy of smelter and mint returns (attach on separate sheet if necessary).....

13. *Cost of Developing Property:*
    - A. Give your idea of the probable cost adequately to prospect or develop your property and how you would proceed .....

14. *Financial Conditions:*
    - A. Total purchase price.....
    - B. Best terms .....
    - C. Are you in a position to deliver title?.....

15. *Equipment:*
    - A. Enter list of principal mining equipment, buildings and other improvements.....
    - B. Names of neighboring properties, stating distance, production, and metal produced.....
    - C. Names and addresses of engineers who have examined your property .....
    - D. Remarks and any additional information.....

Signature .....

Permanent address .....

Date .....

- E. Include copies of any reports you may have on your property. These will be returned to you upon request.

Sketch Map of Property

Show position of claims, shafts, tunnels and section corners. Give scale and direction.

Low-Grade Zinc Mines to Harness Bacteria?

In experiments reported by Rudolfs and Helbronner in *Soil Science*, a culture of organisms was isolated, having the power of oxidizing zinc sulphide to sulphate, without being influenced by the soluble zinc salt. The rate of oxidation was increased by the addition of small quantities of free sulphur. The sulphur-oxidizing bacteria of Lipman produce sufficient acidity to render zinc carbonate and silicate soluble.

Amalgamation and All-Cyanidation

An Inquiry Into Advantages and Disadvantages of Practice at the Various Gold-Reduction Plants of Northern Ontario

By Henry Hanson

In view of the discussion that has recently been published on the opportunities for dishonest sampling in gold-reduction plants, it may be of interest to scrutinize some of the arguments for amalgamation, and those for all-cyanidation.

Those favoring amalgamation say: First, get the gold as quickly as possible; second, crushing in water facilitates good sampling, and the decanted water removes certain soluble salts from one ore that if allowed to accumulate might have a detrimental effect on the solvent action of the solution as well as create other complications and probably a higher consumption of cyanide; third, the theory of absorption is brought in to show how certain particles of primary slime act like a sponge when once saturated with high-grade solution; fourth, it is maintained, and justly, that with fluctuating heads, amalgamation serves to trim down the peaks; that is, any spotty or high-grade ore normally gives up a larger percentage of its values on the amalgam plates and therefore tends to maintain a more uniform cyanide head, which is most desirable where the time factor of treatment has a direct relation to the grade of the ore. These are the salient arguments for amalgamation preliminary to cyanidation.

Advantages of All-Cyanidation Enumerated

For the all-cyanidation practice the following claims may legitimately be made: First, simplification of process; second, initial installation less expensive; third, operating cost lower; fourth, chances for pilfering reduced; fifth, mechanical cyanide losses less, and closed-circuit grinding greatly facilitates dissolution of gold.

Getting the gold as quickly as possible seems the weakest of the claims for retaining amalgamation. It does not make much difference whether the amalgam is obtained in the morning and locked up in a vault, or whether it is precipitated in the afternoon and locked up in a press. The latter have passed through fires without losing their contents. It is admitted that good sampling may be facilitated by crushing in water; it is, however, more important to make profits than to obtain good head samples. On some ores, the building up of soluble salts and their accumulated effect might be such as to make it essential to crush in water. This condition does not obtain in Porcupine, due probably to the glacial action, which has removed the entire oxidized zone, and in few instances, except along fault zones, does oxidation go much over a few inches into the ground. So this advantage in favor of crushing in water does not apply to Porcupine unless the Dome may have certain basic ores that cause trouble. The absorption theory is, on the whole, the most difficult to combat. So far as I know, no great amount of attention has been given this in Porcupine practice, but at Kirkland Lake its importance is well recognized, and agitators have been put into the counter-current system by which the thickened pulp, when raised from the bottom of the first tank, is delivered to an agitating box, where it is diluted with barren solution and whipped into violent agitation mechanically or by air. This, it is claimed, has gone far toward reducing dissolved losses to a minimum. Trimming down the peaks in the heads and thereby maintaining a more uniform grade to the cyanide plant is a decided advantage, when crushing in water, but this, I believe, will be accomplished to approximately the same degree by the use of the double closed-circuit supplemented by concentration. When crushing in cyanide solution, 60 per cent of the values are normally extracted before the pulp leaves the classifier closed circuit.

That all-cyaniding simplifies the practice is irrefutable. The initial cost should be less by at least the cost of the plates, the dewatering or filtering equipment required to remove the water from the pulp, and the additional plant space to accommodate this equipment. The operating cost may be a debatable subject, yet considerable labor is entailed in dressing, cleaning, and steaming plates, and in retorting amalgam. In counter-current plants using filters the mechanical cyanide losses should be practically nil, and a point often overlooked is the fact that the grinding circuit affords unusual facilities for expediting the dissolution of gold. No advantage can be taken of this when the crushing is done in water.

Some may claim that concentration is not so essential when using amalgamation. This would imply that certain free gold overflowing the closed circuit amenable to amalgamation does not dissolve readily and is recovered by the concentrators. If any free gold is recovered by the concentrators it is in negligible quantities, and from this is would appear that the advantages accruing from concentration and the subsequent regrinding and separate treatment of the concentrate are due largely to the finer grinding of this product, which, being the most refractory portion of the ore, gives up its values most reluctantly. I doubt if the practice of concentrating has been given the consideration which it certainly deserves.

Hollinger and Dome Have Somewhat Different Metallurgical Problems to Solve

The difference in practice, at two of the leading Porcupine mines, to the outsiders and the uninitiated, may cause comment, but there is a much greater difference in the character of the ore at the Dome and Hollinger than is generally known, and after a property has been equipped, organized, and thoroughly understood, only unusual considerations justify a change. The Dome started out crushing in water, amalgamating and following this by cyanidation. This was then a well-established and almost universally used practice on gold ores. The Hollinger from the start decided to crush in cyanide solution, take out a concentrate for amalgamation regrinding and separate treatment, and possibly to ship to smelter. The preliminary experiments indicated that amalgamation was not vital, and amalgamation was never attempted seriously. Neither plant has departed far from the basic principle of the original plan.

If it can be established—as there are good reasons to believe that it can—that the final recovery is not retarded as a result of crushing in cyanide solution, then the simpler method would appear to have an advantage. At any rate, the all-cyanide practice has been adopted by all plants that have started in the Porcupine district since the practice was first introduced, and if amalgamation is essential to the most economical reduction of Porcupine ores, somebody is losing money.

THE PETROLEUM INDUSTRY

The Oil Industry of Baku

Running at a Loss Since Nationalization—Continuation of Production Depends on Ability of Soviet Government to Finance Operations

DURING the last few months the oil output in Baku has kept at the same level, about 270,000 tons a month. The record output for the whole period of the existence of the nationalized industry was attained in January, showing 283,000 tons. In February the production was 266,000 tons and in the first half of March 139,000 tons. The total output during these months was approximately 10 per cent higher than for the same period last year. In spite of this improvement, however, the output does not satisfy the monthly requirements of 320,000 tons. The output in the record month was only 41 per cent of the pre-revolutionary production. In 1916 Baku used to produce a monthly average of 685,000 tons.

The improvement in output is due exclusively to the increased numbers of wells under operation and to the developments in boring. The administration of the nationalized industry of Baku has been making strong efforts in this direction, without brilliant success, however. There were 3,000 wells before the revolution. In May, 1920, when the Bolsheviks seized Baku, 1,800 wells were working. During the first year of operation of the nationalized industry this figure fell to 1,200 and rose again to 1,450 by the beginning of the current year. It was the same with the boring works. Before the revolution about 4,500 sajens (1 sajen = 7 ft.) was bored every month. In January of the current year, when the boring attained the highest figures, only 1,577 sajens was bored and only 80 per cent of the proposed program was carried out. The development of the boring depends on a general reparation of the entire plant of the oil works and particularly of the power stations. Such repairs demand, however, a certain amount of money, which is something the Baku industry lacks completely.

At present the financial question is the fundamental one for the Baku works, as it is for the entire Soviet industry. If the institutions managing this branch of industry succeed in obtaining credits, it will be possible to increase the production; if not, the output will not only not be increased, but will suffer a further reduction, as the old wells are becoming exhausted. Whether an increase of production is advantageous is another question. Up to now the position of the nationalized oil industry of Baku was such that each ton of oil produced increased the losses of the entire industry.

The nationalized industry has not shown a deficit up to now, for the reason that the old stocks of oil were being sold, thus helping to cover the balance of the losses over the profits in the current production. From October, 1921, to October, 1922, besides the current production, which amounted to about 2,800,000 tons, about 1,600,000 tons of the old stocks was consumed. There are no old stocks at present. The consumption of the latter is creating the threat of an oil famine in Russia. If up to now the Soviet Government has at times experienced a deficiency of oil in Russia, this was owing to the bad transportation conditions, which could not cope with the bringing away of the oil from Baku. But at present the monthly output of oil even in January (a record month) was 16 per cent behind the relatively modest demands for Baku oil compared with those of past years.

Another result of the consumption of the old stocks will be the necessity for the Baku industry to find the requisite funds for the current production. The "Economicheskaia Jizn" of April 6 contains a report on the situation of the Baku oil industry, showing that the cost price of oil at present, as expressed in gold, is at least twice as high as it was before the war, and that up to now the Baku oil has been sold on the home market at a price which is by 20 to 30 per cent below the cost price.

The report explains this circumstance partly by deficient calculations, and partly by the low fixed prices at which the administration of the Baku industry is compelled to sell the oil to the state institutions which are its chief consumers.

Something must be done to cover the losses of such trading. Up to now they were covered by the sale of the old stocks of oil. In the future they will be covered by credits or simply by state subventions from the funds of the Soviet treasury. For the current year loans to the amount of 22,800,000 rubles have been assigned as a subsidy to the entire Soviet oil industry; out of these the principal part will fall to the share of Baku.

Thus, not only the development but also the continuation of the oil production in Baku depends on how long the Soviet Government will be able to finance this branch of industry, which ever since its nationalization has been running at a loss, though it is not the only Soviet nationalized industry that is reported to be in this condition.

New Method of Roller-Bit Lubrication in Oil-Well Drilling

Lubrication of rotary, or roller, rock bits used in the rotary method of oil-well drilling, by means of the circulating mud instead of oil, as heretofore employed, is being tested at Hull, Tex. It is claimed for this new method that the pins and bearings of the cutting rollers do not wear any faster than when oil lubrication is used. Another advantage claimed is the saving of time, as it is not necessary to come out of the hole every four or five hours to refill the lubricator with oil. These tests are being watched with interest on the Gulf Coast, for if the method proves entirely successful it will be another step in advance in the practice of rotary oil-well drilling.

SOCIETIES, ADDRESSES, AND REPORTS

T. T. Read Describes Air Cooling at St. John del Rey

Deepest Mine in the World His Topic at Recent Meeting of New York Section of A.I.M.E.

At a joint meeting of the New York Section of the A.I.M.E. and the Women's Auxiliary of the Institute, which was held in New York on May 3, the principal speaker was Thomas T. Read, who recently returned from South America. Mr. Read's topic was "The Deepest Mine in the World," and in his talk he gave many interesting facts regarding the St. John del Rey mine, at Morro Velho, Brazil. After briefly describing the ore and the method employed in working it, the speaker turned his attention to the matter of the temperature of the mine workings and summarized the results obtained in the installation of an air-cooling system, devised by Eric Davies (*Transactions*, A.I.M.E. pp. 326-341, Vol. 63), and a 200-hp. Sirocco fan. The average temperature of the air entering the mine during 1919 was 68 deg. F., he said, but with the new installation it was held steadily at 42 deg. F. during 1922. He pointed out the curious fact that the rate of increase of moisture content of the air seems to be nearly uniform from the top to the bottom, although the mine becomes quite dry and almost dusty at the 2,264 ft. level. Mr. Read, in conclusion, spoke most interestingly on Brazil and its people. Referring to wages, he said that though 6 to 8 milreis per day seemed to be the prevailing rate for common labor, nevertheless he did not consider Brazilian labor cheap, because it was inefficient. This inefficiency he ascribed in part to improper habits of eating and drinking.

Carl A. Allen's Life Extolled by Former Associates

Tribute to the memory of Carl A. Allen, former district engineer of the U. S. Bureau of Mines and chief inspector of mines for the state industrial commission of Utah, who died at Washington, D. C., of influenza on April 9, was paid at the weekly luncheon of the mining committee of the Salt Lake City Chamber of Commerce on Saturday, April 14. A paper outlining Mr. Allen's life was read by Dr. A. L. Murray, surgeon of the Bureau of Mines, for many years associated with Mr. Allen in mine safety and rescue work. Dr. Murray told of Mr. Allen's rise through his own efforts to success in the mining profession, from a start with a bare elementary education received in a small farming community at La Junta, Colo. Mr. Allen held at one time the position of assistant professor of mining at the Colorado School of Mines, where he worked out an extension to the Dewey system of classification, which has now been adopted by the mining sections of nearly all large libraries. He was connected with the United States Smelting & Refining Co. for a time, and in 1918 joined the staff of the Bureau of Mines.

Utah Metal Mining Institute Meets in Salt Lake

The Utah Metal Mining Institute held its spring meeting in Salt Lake City on May 4 and 5. The Institute meets twice yearly, once in some mining camp of the state, chosen for the purpose, and once at Salt Lake City. Papers presented during the meeting were: "The Silver King Coalition Mill," by Robert S. Lewis, of the mining and metallurgical department of the University of Utah; "The Tintic Standard Mill," by James Wade; "The Use of the Microscope as an Aid to Ore Dressing," by R. E. Head; "Leaching Process in Practice at the Ohio Copper," jointly by Thomas Varley and George L. Oldright. M. D. Paine talked on "Mine Ventilation," and S. P. Holt on "Sludging."

Fellowships Offered at Rolla School of Mines

The Missouri School of Mines & Metallurgy, at Rolla, Mo., in co-operation with the Mississippi Valley Station of the U. S. Bureau of Mines, is offering four fellowships: one in mining, one in ore dressing, one in physical metallurgy (heat treatment of steel), and one in the electrometallurgy of zinc. The fellowships are open to graduates of universities and technical schools who are properly qualified. The value of each fellowship is $800 for each year of twelve months beginning July 1. Applications will be received until June 15, 1923, and should be addressed to the Director, School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

Anti-legislation Association Organized

An organization known as the Washington State Miners' Protective Association has been organized for the purpose of protecting the mining industry from restrictive legislation. Sidney Norman, of Spokane, has been elected president of the association, with vice-presidents named from each mining county.

Engineering Council of Utah Holds Annual Meeting

Percy E. Barbour Urges Members to Keep in Closer Touch With Headquarters of National Societies

The Engineering Council of Utah met at the Hotel Utah, in Salt Lake City, for its third annual banquet on April 23, with John Lyle Harrington, of St. Louis, president of the American Society of Mechanical Engineers, as guest of honor and speaker of the evening. Mr. Harrington spoke on the engineering profession in its relation to society and to public service, emphasizing the importance of the engineer in the development of civilization.

Other speakers were Senator W. H. King and Congressman E. O. Leatherwood, both of whom spoke in praise of the ethical standards of the engineering profession and its contributions to civilization. Percy E. Barbour, assistant secretary of the A.I.M.E., urged members to keep closely in touch with the national headquarters of their respective organizations.

George H. Dern, acting as toastmaster, called attention to the place of the engineer in civilization, tracing the development of every essential of modern life to the work of the profession. Mr. Dern was introduced by Dr. Joseph F. Merrill, dean of the School of Engineering at the University of Utah, newly elected president of the Engineering Council. H. T. Plumb, former president, opened the meeting.

Bureau Confers with Zinc Men

The initial meeting of the Bureau of Mines advisory committee on the mining, milling, and metallurgical treatment of zinc ores was held in St. Louis May 7. H. Foster Bain, the director of the Bureau, went to St. Louis to confer with the committee as to the problems on which the Bureau should concentrate its research and experimental work. The advisory committee is made up as follows:

George C. Stone, chairman, New Jersey Zinc Co., New York; William N. Smith, Athletic Mining & Smelting Co., Joplin, Mo.; F. C. Wallower, Golden Rod Mining & Smelting Corporation, Joplin; Howard I. Young, American Zinc, Lead & Smelting Co., Mascot, Tenn.; W. E. Mitchell, Anaconda Copper Mining Co., Great Falls, Mont.; Ralph M. Roosevelt, Eagle-Picher Lead Co., Hillsboro, Ill.; Charles Bocking, Butte & Superior Mining Co., Butte, Mont.; William A. Ogg, American Zinc, Lead & Smelting Co., Boston; and George O. Argall, Iron Silver Mining Co., Leadville, Colo.

MEN YOU SHOULD KNOW ABOUT

W. W. Mein has returned to New York from California.

S. F. Shaw is making examinations in Durango and Zacatecas, Mexico.

Augustus Locke has been at Ely, Nev., and is now at Washington, D. C.

Horace Young has been appointed manager of the Moneta property in Porcupine.

Charles Bocking, general manager Butte & Superior Mining Co., is in New York.

Nelson Dickerman has left New York for British Guiana, where he will spend several months.

Hamilton B. Wills, president of the Keeley and Vipond mines, has been visiting the properties.

William Kemp, of Tucson, is making mine examinations in the Barranca del Cobre district, Chihuahua, Mexico.

Thomas Riggs, vice-president of the Continental Mines, has been visiting the company's properties in Cobalt and Kirkland Lake.

Noyes Weltner has been appointed assistant superintendent of the Cia. Minera La Constancia at Sierra Majada, Coahuila, Mexico.

J. K. Walsh, professor of mining and geology at the Oklahoma School of Mines, has been elected president of that institution by the board of directors.

A. H. Hubbell, managing editor, *Engineering and Mining Journal-Press*, is making a field trip through the Joplin-Miami district and the oil fields of Oklahoma.

Carl G. Hamm has left the Tonopah Extension Mining Co., and is now manager of the arsenic plant of the Cia. Minera de Peñoles at Mapimi, Durango, Mexico.

James P. Porteus, of Lordsburg, N. M., is making a survey of general mining conditions, covering all the active camps in Arizona, New Mexico, and southern California.

James MacNaughton, general manager of the Calumet & Hecla and subsidiary properties in the Michigan copper district, has returned from a business trip to Boston, Mass.

Rush J. White, of Wallace, Idaho, mining engineer and manager of the Coeur d'Alene Syndicate Mining Co., is in Los Angeles to confer with the officers of the syndicate company.

Hans Menck, of Hamburg, Germany, owner of coal mines in the Ruhr district, was a recent visitor on the Mesabi iron range, where an inspection of open-pit mining and equipment was made.

Fred P. Shayes, chief of the engineering department of the Minerals Division, Louisiana State Department of Conservation, has resigned to accept the position of geologist with the Houston Oil Co., with headquarters at Camden, Ark.

Fred Marston, who recently resigned as mill superintendent for Alvarado Mining & Milling Co., Parral, Mexico, is now mill superintendent for the Tennessee Copper Co., Ducktown, Tenn.

M. C. Lake, geologist for the M. A. Hanna Company, and **Dwight E. Woodbridge**, both of Duluth, are near Port Arthur, Ontario, where the Hanna company is exploring for iron ore at Loon Lake about 20 miles from Port Arthur.

Harris & Ewing

John Briar
Commissioner War Minerals Relief

John Briar, who had served as Assistant Commissioner, War Minerals Relief Commission, since July, 1921, has been appointed Commissioner of that body. He will give particular attention to the disposal of the smaller and simpler war mineral claims.

McHenry Mosier has been appointed assistant mine superintendent at the Morenci Branch, Phelps Dodge Corporation. He will continue in charge of the engineering department. **Ed. Curnow** is now foreman, Humboldt mine, and **John Martin** stope foreman.

James S. Douglas, president of the United Verde Extension Mining Co.; **George S. Kingdon**, general manager, and **S. B. Applewhite**, secretary, are visiting the principal copper camps in the Southwest, including Chino, Tyrone, Clifton-Morenci, and Globe-Miami.

According to an announcement recently issued by the Board of Conservation and Natural Resources of the State of Illinois, **Dr. Morris M. Leighton** has been appointed Chief of the State Geological Survey, to succeed **Frank W. DeWolf**, who resigned on March 20.

John Malcolm Schloss, mining engineer, of New York, is on his way to Africa on oil exploration. He may be reached care of Camphania de Petrolio de Angola, Caixa Postal 315, Loanda, Angola, Portuguese West Africa.

Dr. F. W. McNair, president of the Michigan College of Mines at Houghton, and members of the faculty are engaged in a series of studies having to do with the plans for the proposed new metallurgy building to replace the one destroyed by fire some time ago.

Dr. H. M. Ami, of the Canadian Geological Survey, has given $300 to McGill University to establish a Fellowship in Geology for the session 1923-24. Dr. Ami is now in the south of France investigating a cave believed to have been inhabited in prehistoric ages.

Dr. Leopold Reinecke, formerly of the Geological Survey of Canada, and recently with the Sinclair Oil Corporation, in Angola, has begun practice as a consulting geologist in Johannesburg, Transvaal. His office is at 44 Sauer's Buildings, and his address P. O. Box 2682.

A. C. Spencer, of the Geological Survey, has returned from Cuba. **David White, W. T. Thom, O. C. Postley** and **A. M. Farrell** are doing field work in western Maryland, West Virginia, and Pennsylvania. **F. J. Katz** will visit Birmingham, Knoxville and other points in Alabama and Tennessee.

Dr. F. W. Stillwell, mining geologist of Melbourne, Australia, is in San Francisco after a short visit to Leadville and Cripple Creek, Colo., and Jerome and Globe, Ariz. Mr. Stillwell is en route to Virginia City, Nev., and will visit the Mother Lode and Grass Valley districts of California before returning to Australia.

E. C. Guerin and **W. T. Foran**, of the Geological Survey, are en route to Alaska, where they will assemble supplies and equipment for use by three parties in a survey of naval Petroleum Reserve No. 4. **R. K. Lynt** will sail from Seattle on May 24, in charge of a party that will make geologic and topographic surveys in the Cold Bay region of Alaska. **F. H. Moffitt** will sail from Seattle May 26 to make geologic surveys in the Prince William Sound region of Alaska.

OBITUARY

Dr. Frederick Salathe, oil geologist and chemist, and one of the pioneers of the oil industry in California and Wyoming, died recently at Santa Barbara, Calif., in his sixty-sixth year.

Paul Kreuzpointner, metallurgist and writer, died at his home in Altoona, Pa., on May 7. He was eighty-one years old.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded

Leading Events

LABOR ORGANIZATIONS representing the International Union of Mine, Mill, and Smelter Workers, and the Industrial Workers of the World (I. W. W.) are reported to be actively engaged recruiting members in Arizona copper camps.

A "Blue-sky" law passed by the Ontario Legislature does not become effective until after next election. It may be modified.

The directors of the Davis-Daly Copper Co. decry efforts on the part of sundry stockholders to force a compromise of apex litigation with the Anaconda Copper Mining Co. without knowing all the facts.

The new concentrator of the Eureka-Holly company at Eureka, Nev., is making $120 concentrate.

Leaching "in place" at Lark, Utah, is pronounced so successful that the Ohio Copper Co. has ordered equipment to increase operations tenfold.

Development in Central Idaho reveals good gold ore in several mines.

Washington officials report that the Anaconda company has asked for assistance in getting 1,000 workers.

The Utah Apex company has declared a 50c. dividend, the first in several years.

Rutgers College, at New Brunswick, N. J., has been awarded the new "non-metallic" experiment station of the U. S. Bureau of Mines.

The Keeley Mines Co. plans to increase the capacity of its mill at South Lorrain.

Labor Organizers Appear in Arizona Mining Districts

Unionization Will Get Wages Comparable With Those Paid to Tradesmen, They Preach

The appearance of labor organizers has been noted in various mining camps of Arizona. In many places meetings have been conducted in which the speaker expounds the benefits of the miners' union. Representativs of the International Union of Mine, Mill and Smeltermen are attempting to effect a reorganization of their forces in the Globe-Miami district, and meetings for the same purpose have been held in Bisbee and other copper-mining camps in the state.

Advance agents of the I. W. W. are also to be seen in the Arizona districts, and recruits are being solicited and literature distributed. These are the first activities of those organziations to be evidenced since the numerous labor troubles throughout the state during the war. Speakers advance the argument that the shortage of men is due to the fact that the miners have migrated to other work, where, because of organized efforts, the union men have been able to obtain better wages and working conditions. They claim that the miner will be able to obtain a wage commensurate with that of the other tradesmen if complete organization is effected.

Reports indicate that the union men are anything but friendly to the members of the I. W. W. organization and the more conservative men are opposing the so-called radicals.

Eureka-Holly Makes $120 Concentrate at New Plant

The milling plant of the Eureka-Holly Mining Co. situated in the Eureka district, Nevada, is in operation and treating an average of about 35 tons per day, with every hope of an increase to 50 tons. With table concentration only a saving of but 60 to 70 per cent can be made. Flotation tests now being made indicate that a much higher recovery can be made by flotation, and it is likely that a flotation unit will soon be added. Concentrates average $120 per ton. The shaft is to be sunk to the 1,000 level, and company engineers consider chances for finding profitable orebodies below the 800 level as being very favorable.

Anaconda Company Seeks Government Help in Obtaining Miners

The United States Employment Service, Department of Labor, has been asked to assist in obtaining 1,000 miners for the Anaconda Copper Mining Co. for its operations at Butte, Mont. According to C. D. Greenfield, Jr., director of the Federal Employment Service at Helena, W. J. McMahon, labor commissioner for the mining company, has requested the assistance of the Butte Chamber of Commerce in recruiting men for the mines, at $5.25 a day company rate and from $6 to $7 a day on contract, board being offered at $9 a week and house rent at an average of about $5 per room monthly.

Ohio Copper Co. Will Leach "in Place" on Large Scale

Experimental Work Successful—New Pumping Equipment Being Installed

The Ohio Copper Co., which has for some time been making experiments with leaching "in place," with successful results, is now arranging for production on a commercial scale. The company operates at Lark, near Bingham, Utah. It is planned to install equipment which will permit of the distribution of 1,500 gal. of water per minute. The company is using only 150 gal. per minute with its experimental installation. Relay pumping stations are to be put in on the Mascotte tunnel level, on the 750, 400, and 100 levels. The equipment will be so arranged that operation will be automatic, and one man can attend to the pumps. The company has just finished installing its last launder, so that there will be a total of 3,200 ft. of launders, 1,600 ft. on each side of the Mascotte tunnel track, and no more launders will be put in for the present. If, when the new pumping plant has been installed and the amount of water handled increases, the percentage of recovery drops to a point considered too low, more launders will be provided. Pending the completion of the new installation, the experimental plant will continue to operate. Production cost including mining, smelting, and freight charge is given as 7c. per pound of copper. The ground being leached was partly caved by operations several years ago.

Yukon's Future Not Dark in Eyes of Gold Commissioner

Mayo Looks Like Permanent Lead-Silver District—Still Some Gold Near Dawson

By Robert Dunn

THE TOTAL value of the metal output of the Yukon territory is estimated as follows: gold, $200,000,000; silver, 3,500,000 oz., valued at $2,100,000; lead, 3,500 tons, valued at $400,000; and copper, 12,000,000 lb., valued at $2,700,000.

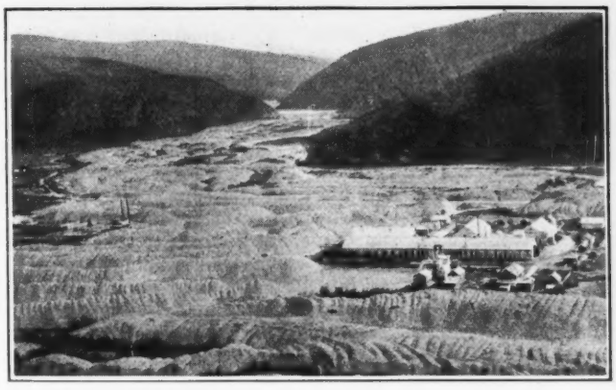
Hitherto silver has been obtained chiefly as a byproduct in the refining of placer gold, 2,000,000 oz. of the total given being so accounted for. About 1,500 tons of silver-lead ores were shipped from the Mayo district in 1914-15, after which production ceased until new leads were discovered on Keno Hill. From this source during 1921-22 about 5,000 tons of ore was shipped, yielding approximately 200 oz. per ton in silver and 60 per cent in lead. The production of the Mayo district this season is expected to total at least 8,000 tons of ore of similar grade to the output of the previous year.

The development of a permanent high-grade silver camp at Mayo now seems to be assured. Many of the 1,500 claims recorded show well-defined outcroppings of silver-lead ores. Three properties have been developed to a considerable extent, and two of these, one backed by Treadwell interests and the other by the Yukon Gold, are shipping regularly, with every prospect of increasing output to the capacity of transportation facilities. The cost of production, shipment, and treatment at present is about $100 a ton, and for that reason only the higher grade ore can be profitably handled. The product first is hauled 40 miles, either by horses or gasoline tractors, to the banks of the Stewart River, and thence is transportated by river and ocean vessels, via the mouth of the Yukon River, to Pacific Coast smelters.

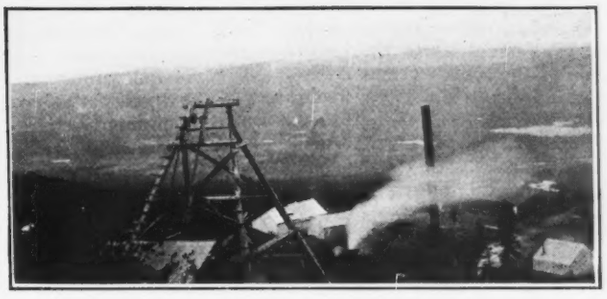
The camp now is easily accessible. There are good winter roads. During the winter it can be reached by stage from White Horse and in the summer by steamboat. Plenty of timber is available for mining needs, and water-power is abundant. Fraser Falls, on the Stewart River; the Canyon, on Mayo River, and Janet Creek, all close to operations, can be developed to produce all the power that may be required.

The area within 50 miles of Dawson is the chief placer field; it has been operated intensively during the last twenty-five years. George P. MacKenzie, Gold Commissioner for the Yukon, divides the life of a placer gold district into three phases: "the primitive," covering the period of wood fires and small open cuts; "the mechanical," when, although the operations still are conducted by individual operators, steam power is used to operate certain types of machinery, and "the corporation" period, which entails the formation of holdings extensive enough to warrant a large capital expenditure on account of plant.

He says that the placer fields immediately surrounding Dawson may be considered to have passed through the first two phases. A part has been cleaned up as to the third phase, but "there still remains an area which will keep available plants, both dredging and hydraulicking, occupied for many years. It is not easy to forecast the life of these operations, but it is safe to say that they will continue for twenty years, and should maintain or exceed the present annual output of something over $1,000,000 per year."



Yukon Gold Co.'s No. 1 shaft on Keno Hill (above)
Placer tailings at the mouth of Bonanza Creek (below)



White Horse Rapids on the Yukon (above)
Treadwell-Mayo camp on Keno Hill (below)

Manganese Exports From Brazil Increase

Total exports of manganese ore from Brazil in 1922 were 340,706 tons, an increase in quantity over 1921 exports and a decrease as compared with 1920, according to a report to the Department of Commerce from Rio de Janeiro. Figures of exports for two years, in gross tons, with the average price per ton are given as follows: 1922, 340,706 tons, $65; 1921, 275,694, $83.

Foreign Gold Output

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, May 12—The output of gold in the Transvaal during April totaled 743,651 oz. Production of gold in India during April amounted to 32,307 oz. The output of gold in Western Australia during April totaled 41,653 oz.

Davis-Daly Shareholders Hold Divergent Ideas on Litigation

Officials Criticize Desire To Compromise "Apex" Suit With Anaconda on Unfavorable Terms

Sundry unnamed stockholders of the Davis-Daly Copper Co. are taken to task by Charles G. Shirmer, secretary of the Davis-Daly company, acting for the directors, for attempting to effect a compromise with the Anaconda Copper Mining Co. in the apex litigation started at Butte. A large part of the Colorado mine is involved in the dispute. The following is from a report dated May 1:

"Operations during this period (three months ended March 31) were conducted in a restricted area due to the decision of Judge G. M. Bourquin enjoining both the Anaconda Copper Mining Co. and your company from mining ores in the territories in dispute. This indeed was unfortunate, as it necessitated mining lower grade ores and developing new territory. At the hearing in Butte last January, the Anaconda Copper Mining Co. asked for a period of about six months for the purpose of further development, in an effort to prove its contentions and claims; up to the present writing it has done considerable work and spent a large amount of money in controversial development, and we are advised that the work done under this development has not strengthened the claim of the Anaconda company, which gives your directors much encouragement as to the eventual outcome of the controversy. As previously reported, your directors made several unsuccessful attempts, before the starting of legal proceedings, to bring about a compromise with the Anaconda Copper Mining Co., offering liberal concessions, but the demands of the Anaconda company were such that it would necessitate our conveying to it a large portion of our most valuable claims.

"We believe our shareholders have shown much loyalty and they realize that the officers and directors are conducting the controversy for the best interests of all the shareholders; one of our shareholders has recently made an effort to induce your directors to make a settlement, which settlement they firmly believe would be exceedingly detrimental to the good of the company. The directors hope that every shareholder will feel at liberty to confer with the company's officials before committing themselves in the attempts of certain selfish individuals, who do not know the details and intricacies of the situation, to effect a compromise with the Anaconda company. Your directors would heartily welcome and entertain any reasonable offer of compromise from the opposing side, thereby saving much unnecessary expense which litigation always entails, but our optimism inspired by the opinions of our engineers and legal talent, precludes us from sacrificing the property and the interests of our shareholders. We feel confident that our neighbors will eventually see the injustice of their claims against the little brother; if not, we are satisfied to rely on the uncompromising justice of the court."

J. L. Bruce, general manager of Butte, has been in Boston conferring with officials regarding the litigation.

C. & A. Steel Order Goes to Arizona Firm

The Calumet & Arizona Mining Co. has placed an order for more than 1,000,000 lb. of structural steel with Arizona contractors, to be used in the construction of the company's new concentrator at Ajo. This order was given the firm of Roy & Titcomb, of Nogales, and is said to be the largest single order ever given an Arizona contractor. This is in keeping with the method adopted by all of the large companies operating in the state during the last year, and supplies of all kinds are now purchased from Arizona merchants and firms if possible. This policy has been expounded by the Arizona Industrial Congress.

Gross Mine Output of $13,809,856 Leaves Net Profit of $3,587,783

Record of Coeur d'Alene Properties in Idaho During Year 1922—Balance Is Production Cost

Under the Idaho law, all productive mines are required to file on or before the first day of May sworn statements with the county assessor giving the details of operations covering the preceding calendar year. These statements include tons of ore produced, gross value, cost of extraction, freight and treatment charges, expenditures for betterments and repairs, and net profit or loss. In addition to paying the usual property tax, mining companies in Idaho are also subject to tax on their net profits, and it is for the purpose of determining the profits for taxation that these statements are required. Aside from this purpose, the statements give an interesting insight into the enormous expenditures made in mining operations. The following figures give the gross value of ore produced by the companies and their profits in 1922:

	Gross Value	Net Profit
Bunker Hill and Sullivan	$5,171,228.19	$1,667,523.28
Caledonia	90,028.78	19,137.28
Sierra Nevada	153,658.02	57,198.31
Hecla	3,398,543.82	1,311,645.40
Federal	3,322,820.01	481,457.18
Mike Savage Lease	65,016.92	25,261.32
Yukon Gold (dredge)	124,027.88	20,081.63
Total	$13,809,856.82	$3,587,783.86

Net losses during the year were reported by the following: Hercules, $98,527.25; Tamarack, $66,160.77. These were inactive the first half of the year. As against the gross value of ore produced, the following deductions were made: Cost of extraction, $5,521,228.93; freight and treatment, $4,399,409.18; betterments and repairs, $522,048.20. In 1921 the same companies (excepting Mike Savage lease) reported gross value of product, $10,954,019.16, and net profits, $1,883,337.29.

"Blue-sky" Law Passed by Ontario Legislature

Election May Alter Situation—Requirements of Act—What Is a "Professional Mining Engineer"?

The Sale of Securities Bill, otherwise known as the "Blue-sky" law, has been passed by the Ontario Legislature. However, it will not go into effect until September and then only by proclamation, as there is to be a provincial election in June, and it is possible that there will be a change of government, and that the bill may be altered before it goes into effect. Some anxiety is felt by the mining interests, because it is feared that new promotions may be so restricted that it will be difficult to finance properties, but it is doubtful if the bill will have this effect. The main purpose behind the law is to give control over new promotions, so that existing companies are exempted. There is also no provision in the act to stop the sale of stock of companies promoted outside the province. If the act goes into force, a complete statement will be required of promoters as to the organization of the company; material contracts must be given in detail; there must be full mention of all considerations, the interest of all directors, and details of the purposes to which the proceeds of the issue will be principally applied. A statement that the amount to be raised will be reasonably adequate for the purpose of the issue will be required and all other matters connected with the issue must be covered fully.

A purchase of securities will not be binding unless a copy of the prospectus is delivered before or at the time of the purchase, but in order to take advantage of this clause the purchaser must act within fifteen days after notice that his subscription has been accepted or that his purchase has been concluded. Brokers and salesmen must register with the commissioner, who shall have authority to decide whether or not shares may be sold. In the case of a mining company, the report of a professional mining engineer is required, but no definition is given of what constitutes a professional mining engineer.

Strange Talk From Minerals Separation Representatives

A party of eight representatives of Minerals Separation recently spent considerable time at Superior, Ariz., where they examined the flotation process of the Magma Copper Co. The examination was made upon the assumption that the process employed at the Magma mill was an infringement upon the Minerals Separation patents. One of the engineers is quoted as saying that the question of suit had not yet been decided, but that if the process was found to conflict with the corporation's patents it was thought that the matter would be settled amicably. This is an unusual attitude for a company which has won a universal reputation as a hard-boiled "patent exploiter."

Development Opens Ore in "Central Idaho" Gold Region

Old Camps Being Revived — Better Transportation Needed — Modern Ore-Treatment Methods Help

BY EDWARD M. GRIFFITH

Recent strikes of gold ore made in sundry properties of the Elk City, Dixie, Buffalo Hump, Orogrande, and Ten Mile districts, all forming practically one compact region, known as Central Idaho, are attracting wide attention. An area about 40 miles square includes the districts named. About twenty-four years ago, the discovery of bonanza gold, made in the Buffalo Hump camp, started a rush to the district. Hundreds of thousands of dollars was recovered by stamp milling and amalgamation. The ore was obtained principally from the oxidized portion of the oreshoots, and from comparatively shallow workings. However, with depth the ore changed to a sulphide, carrying base metals. When the cream of the oxidized ore was mined operations were discontinued. Many of the owners, however, procured United States patents for their properties and have held them since.

Another handicap to successful operations was the lack of economical transportation. This is still a drawback, although improvement in roads has been made during recent years. I believe that if the same mineral showing existed in Canada, or other British possession, the British Government would have built suitable roads into them years ago. The government has undertaken the construction of a truck road from Grangeville, the county seat of Idaho County, to Elk City, which, when completed, will practically solve the transportation problem for this whole section. Construction work is suspended for the time being, but effort is being made to have it resumed.

The American Eagle has opened two shoots of ore 5 ft. in width. The ore, I am informed, is so rich that it could be properly called specimen ore. This property is in the Elk City district. In April miners working on the French Creek property, which was recently incorporated by local people, opened 4 ft. of rich ore. This property is in the vicinity of the American Eagle.

The Gold Zone property, owned largely by local people, recently opened 9 ft. of ore showing samples up to $48 in gold, at a vertical depth of over 200 ft. This ore was encountered in a crosscut from an 800-ft. tunnel, the shoot being over 200 ft. long. This property is situated in the Orogrande district.

The Center Star property, situated in the Ten Mile district, shows 24 ft. of good milling ore at depth of 275 ft. This is one of the big properties of this section.

The War Eagle, situated in the Buffalo Hump camp, is another mine with a remarkable showing. At a vertical depth of over 200 ft. 12 ft. of ore has been opened, 4 ft. of which averages $200 per ton. This showing was made last December, and in the dead of the winter. Much activity is promised on this property during the summer. The Concord group, in the Hump camp, according to an engineer's report shows 7 ft. of ore averaging $40 per ton; 8 ft. $18.80; 17 ft., $6.80; 5 ft., $24. There is a shaft 300 ft. deep on this property.

The St. Louis property shows at a depth of 100 ft. and below the zone of oxidation 4 ft. of ore averaging $60 per ton. The Liberty Bell group shows 8 ft. of ore averaging $30 per ton.

A feature of the ores of this section is that their principal value is in gold; there is little silver. Modern methods of ore treatment are now being considered, and it is hoped by those who have been making a study of the ore that it can be treated to produce bullion on the ground without shipping to a smelter. The ores have been concentrated experimentally.

Boleo Copper Has Expanded Operations in Mexico

The Boleo Company, which is owned by the French Rothschilds, is doing the largest business in its history at its mines near Santa Rosalia, in lower California. The company has just finished making extensive improvements to its properties, including the construction of reverberatory furnaces and a refining plant. All of the copper produced by the company is now refined at this plant and the product is shipped to Europe on steamships owned by the company. The company has recently greatly enlarged its operations by opening a new copper mine in the San Antonio-Triunfo district. Although Santa Rosalia has no rail transportation facilities and is remote from populous centers it is modern in its improvements and public service equipment. The town is practically owned by the Boleo Company.

News from Washington

By PAUL WOOTON
Special Correspondent

"Non-Metallic" Experiment Station Awarded to Rutgers College

Bureau of Mines Gives Reasons for Selection of New Brunswick School—Pennsylvania Leading Producing State

RUTGERS COLLEGE, at New Brunswick, N. J., has been chosen as the location for the new mining experiment station of the Bureau of Mines. The new station will specialize in problems involved in the production of utilization of the non-metallic minerals.

Before recommending a location for this station, a careful survey of the entire country was made by the Bureau of Mines. The choice finally narrowed to New Brunswick, Baltimore, and Knoxville, Tenn. New Brunswick finally was chosen because nearly all of the talc output of the country is produced in the North, as is two-thirds of the feldspar, three-fourths of the silica, nine-tenths of the slate, and three-fourths of the building stone. In addition, the gypsum, refractories, fluxing stone, monumental stone and dolomite output is confined almost entirely to the North. This makes New Brunswick a central location with reference to the production and consumption of the non-metallic minerals. The total production of non-metals north of the Potomac is $245,000,000, and $92,000,000 south of the Potomac. The adjacent state of Pennsylvania, alone, has 1.7 times as great a production of non-metallic minerals as have all of the states south of the Potomac and Ohio rivers combined.

During the last several years in which the non-metallic station's location has been under consideration, the opinion has been that it would be located in the South. Knoxville was known to be at the geographic center of southern mineral deposits. The University of Tennessee offered cordial co-operation and proffered ample floor space for the Bureau's laboratories and offices. A detailed survey of the situation, however, revealed that there is a comparative dearth of problems in the South that would benefit any large group of producers in the non-metallic industries. The largest non-metallic industry in the South is sulphur, controlled by three companies. The phosphate rock industry is next in size, most of which is in the hands of five fertilizer companies. Portland cement is next in importance, but three-fourths of that industry is north of the Potomac. The bauxite industry ranks fourth, but it is controlled largely by one company.

On the other hand, the large industrial cities are the principal points of the non-metallic mineral consumption. The consumers' needs have a direct bearing on the producer's problems, and close co-operation is required. The location of New Brunswick, midway between New York and Philadelphia, is ideal for contact with centers of consumption. Fully 75 per cent of the non-metallic consuming industries are within easy reach of New Brunswick.

Rutgers College has a library of 120,-

000 bound volumes, and is well equipped with books of the type required in the station's work. Its collection of works on mineralogy is particularly complete. The libraries of Princeton University are only 15 miles distant. Those of New York City and of the University of Pennsylvania are readily accessible. State support for the bureau's work is probable.

While Baltimore is sufficiently well located with respect to the producing and consuming industries, the work of the Bureau of Mines is distinctly applied science, a field which Johns Hopkins University shows no tendency to develop. The university has no mining school and no facilities that would assist in problems of mining and milling. Moreover, the housing which the university could offer the station would be cramped for the present at least. The university is not a state institution, and as a state university exists in another location, state appropriations to augment the work of the station hardly could be expected.

Oliver Bowles will be superintendent of the new station.

Sponge-Iron Process Success, Says Bureau of Mines

Production of sponge iron on a commercial scale at a satisfactory cost is the outcome of several years of experimentation on the part of the Bureau of Mines. The material is used both as a precipitant and for subsequent conversion into iron and steel products. The Bureau of Mines process is a modification of well-known practice. Crushed ore and raw coal in equal proportions are fed into a direct-fired rotary kiln much as in standard cement kiln practice. After passing through the furnace, the discharged product is cooled and concentrated on dry magnetic separators. The process has the advantage of low first cost and simplicity of operation. Any kind of scrap iron can be used, and the product has proved to be ideal for use as a precipitant for copper and other metals in hydrometallurgical operations. It also is highly suitable for subsequent conversion into foundry iron-ore steel.

Investigate Extraction of Radium From Ores

S. C. Lind, physical chemist, and D. C. Bardwell, assistant physical chemist, attached to the Rare and Precious Metals station of the Bureau of Mines, at Reno, Nev., report plans in connection with the recovery and extraction work of radium from ores. The Reno station has taken up a problem which has long been waiting for attention—the co-precipitation of radium and barium from solution. An attempt will be made to determine whether the phenomenon is one of adsorption, and how complete the co-precipitation is, and other similar points. Attention will also be paid to some recent claims of the separation of radium and barium by fractional precipitation as chromate in acid solution.

Stage Set for Senate Gold-Silver Inquiry

Commission Outlines Scope of Investigation—Foreign Negotiation Authorized—Oddie Head

The Senate Commission of Gold and Silver Inquiry met on May 8, 1923, to organize its work of investigation and research. The personnel of the commission is as follows:

Senator Tasker L. Oddie, of Nevada, chairman; Senator Key Pittman, of Nevada, vice-chairman; Senator Thomas Sterling, of South Dakota; Senator Frank R. Gooding, of Idaho; Senator Thomas J. Walsh, of Montana; H. N. Lawrie, assistant to the commission; C. E. Alden, secretary.

The resolution charges the commission with responsibility to investigate and report to the Congress on Jan. 1, 1924, upon the following subjects:

1. The causes of the continuing decrease in the production of gold and silver.

2. The causes of the depressed condition of the gold and silver industry in the United States.

3. The production, reduction, refining, transportation, marketing, sale, and uses of gold and silver in the United States and elsewhere.

4. The effect of the decreased production of gold and silver upon commerce, industry, exchange, and prices.

The commission was further authorized:

1. To confer with citizens, associations, or corporations of foreign countries with a view to the stabilization and wider use of silver in exchange.

2. To propose, either formally or informally, to the President of the United States, or the heads of the proper departments, plans for negotiations with foreign governments to the same end.

H. N. Lawrie was appointed assistant to the commission to serve in a consulting capacity in formulating and executing the program of investigation. Mr. Lawrie is acquainted with the operative side of mining and served as economist for the American Mining Congress from 1919 till 1921; he is now managing director of the American Gold and Silver Institute. Mr. Lawrie has made an intensive study of the economics of gold and silver throughout the world. Because of his practical experience in mining, and his knowledge of the economics of gold and silver, Mr. Lawrie is well qualified to render valuable assistance to the commission in carrying out successfully its program of investigation.

The crisis confronting the gold and silver mining industry is even more serious than that which confronted the agricultural industry, when a Congressional commission was appointed to investigate thoroughly the condition of that industry. From this investigation remedial legislation resulted. A failure to restore normality to the gold and silver mining industry during this crisis will be far reaching in its effect upon the future prosperity of the nation, and it is the purpose of the commission to safeguard the public interest in that important field.

Pittman Act Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended May 12 mounted to 4,473,233 fine ounces. This brings the total purchases (including tenders for future delivery) under the Pittman Act to 188,507,817 fine ounces.

Arsenic Production Now Estimated at 15,000 Tons, Not 22,000

A sharp cut in the "probable production" of white arsenic for 1923 has been made by the U. S. Geological Survey. The figure is now 15,000 tons, instead of 22,000. V. C. Heikes estimated the production in 1923 at 22,000 tons of refined white arsenic and 5,000 tons of crude arsenic. He said: "The imports from Mexico may amount to 5,000 tons and those from other countries will probably raise the total to 35,000 tons. This estimate does not include the possible output of several small operators who may further increase the domestic output before the end of the year." The prediction of a production more than double the 1922 output caused much comment in the trade, the statement being made that the department was either grossly misinformed or had made a faulty interpretation of the trends.

G. F. Loughlin, in explaining the estimate of a 22,000-ton output and the 5,000-ton Mexican importation, said that the statement erred in declaring that the estimates were based on operations during the first quarter; in reality they had been based upon the expected increase in the capacity of plants turning out white arsenic.

Bureau Wants Data on Brine and Nitric Acid Treatment of Ores

O. C. Ralston, one of the metallurgical engineers on the staff of the Bureau of Mines, is collecting in a single paper all of the available information on nitric acid treatment of ores. While he realizes that this report will be largely a history of failure, he does not believe that all of the hopeful possibilities of this method of ore treatment have been exhausted. He is not convinced that its application is prohibitive in connection with the treatment of complex rare metal ore.

Mr. Ralston also is reviewing the development of brine leeching for lead in hydrometallurgical operations. Brine leeching has been tested in numerous semi-commercial operations and is under contemplation in others. He expects to bring up to date the bulletin on this subject, of which he is the co-author with Dorsey A. Lyon. The Bureau is anxious to hear from anyone having information on brine leeching or nitric acid treatment, so that publication can be made of the latest thought on these processes.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Champion Reef Outlook Gloomy—New State Areas Starts Mill

BY W. A. DOMAN

London, May 3—The feature of the 1922 report of the Champion Reef Gold Mines of India is the ore-reserve position. This is by no means strong, whether viewed from the standpoint of tonnage or gold content. During the year, 142,242 tons was milled, and as at Dec. 31, 1921, the estimate of reserves was 221,946 tons, there was left only 79,704 tons. The total at Dec. 31 last was 209,043 tons. Not all of this, however, was exposed during the year. In the ordinary way the difference of 129,339 tons would be accounted for by new development, but 40,000 tons not included in previous computations have been brought in, leaving 89,339 tons to represent "a considerable area formerly reserved as pillars" and new ore. At last year's rate of depletion there is less than eighteen months' supply; in consequence, and pending tangible results from development, the quantity milled is to be reduced to 9,000 tons monthly. While the ventilation of the mine was being improved, the deeper levels were not actively opened up, and this explains the ore-reserve position.

In the shallower levels, operations were actively pressed. On the East reef no discovery of importance was made, but to the north of Carmichael's shaft a new shoot of ore was discovered at levels 56 and 57. At the latter horizon 150 ft. of quartz averaged 3 ft. 7 in. in width and 1 oz. 12 dwt. of gold in value. During 1923, level 59 has entered the shoot, giving a value of 1 oz. 8 dwt. over a width of 4 ft. In level 65, south of Carmichael's shaft, quartz assays 1 oz. 17 dwt. over 1 ft. 9 in. and a winze below shows 2¾ oz. over 1 ft. No dividend is being paid.

The Ivanhoe Gold Corporation (Kalgoorlie) dies hard. The rate of dividend is falling off, it is true, and the mine is hampered by heavy expenses. There is still £1,139,469 worth of gold in the reserves of 692,014 tons, an average of 32s. 11d. per ton, but set against last year's level of working expenses, 32s. 6d. per ton, the amount available for distribution, after allowing for loss in extraction, will not be great. Ore milled last year was 178,406 tons, for an average of 8.06 dwt., against 153,583 tons in 1921, for 7.88 dwt. In future a greater tonnage of accumulated residues will be treated. The bulk of the reserves average approximately 30s., the small quantity opened up on the 2,420 ft. level on the East lode being worth only 21s.

A cable from Johannesburg announces that a section of the treatment plant of the New State Areas started on May 1. This is the latest of the Rand gold mines to enter the producing list. The payable proportion of development work last year was rather below the average level of other Far East Rand mines, 56 per cent of reef averaging 28.3 dwt. over a width of 22 in. Including ore of 4.5 dwt. which at present is below the pay limit, 1,100,000 tons is fully developed and estimated to average 8½ dwt. over a stoping width of 68 in.

Owing to the remarkable development of its British Columbia property, the directors of the Selukwe Gold Mining & Finance Co. are making an issue of reserve shares of the nominal value of 2s. 6d. at 20s. per share, in the ratio of one new for ten already held. With this addition the company's paid-up capital will be only £103,385.

San Francisco Letter

Second Steel Company Probable—Small Mill in Plumas Copper Belt

Special Correspondence

San Francisco, May 7—Local papers foreshadow the organization of another Pacific Coast steel company. The new company will be known as the Pacific Steel Corporation of Delaware. A. C. Denman, Jr., president of the Southern California Iron & Steel Co., recently in San Francisco, refused to make any statement about the new company; however, he intimated that several coast steel firms are incorporating as a single unit under the laws of Delaware. In the meantime the Columbia Steel Corporation has successfully floated a $4,000,000 bond issue, one-half of the bonds being absorbed on the Coast and one-half going to Eastern banking interests. At Pittsburgh, Calif., the foundations of the open-hearth furnace plant and the new rolling mill have been completed. The plans for the blast-furnace plant to be installed at Provo, Utah, have been completed and construction will be started in the near future. The State Mining Bureau, which, after all, is not to be abolished, but which has been allowed a small appropriation, will consolidate its district offices at Redding and Auburn into a single office in Sacramento. This office will have charge of the gold and copper division and all field activities in the Mother Lode district and in the mining districts north of Sacramento.

The small surface plant at the Alta Hill mine has been completed by the Hilltop-Nevada Co. and shaft sinking will be resumed. Milling operations at the North Star have been slightly curtailed and development work is being extended. At the Baltic mine, near Grass Valley, the adit has reached a length of 1,550 ft. and is believed to be within 200 ft. of the Alta Hill gravel channel.

The principal operating mines on the Mother Lode are the Plymouth, the Fremont, the Central Eureka, the Kennedy, the Moore, Carson Hill and Melones, and the Belmont-Shawmut. The Argonaut is expected to resume mining within a month. At the Plymouth, the winze has been sunk to a depth of 3,957 ft., exposing the vein at this level, over 8 ft. in width and of an average value of $13 per ton. The 3,925 level south drive has been advanced, as well as the 3,850 level south drive on the oreshoot, and good milling values are indicated. The Central Eureka has opened an orebody on the 4,250 ft. level and is operating 40 stamps.

Montreal Letter

All of Hollinger for Sale, or None—Labrador Adventurers Wait for June Weather

BY ALEXANDER GRAY

Montreal, May 11—Circumstantial stories persist as to the likelihood of Hollinger control passing to Joel interests in London. President Timmins and general manager Brigham, it is reported in New York, are in London. The object of these continuous misstatements cannot be ascertained. Mr. Timmins and his associates are not thinking of parting with control. Were any such decision probable they would prefer, no doubt, to retain no remnants; for they and their intimate friends hold about 80 per cent of the stock outstanding—and London would have to take all or nothing. Mr. Brigham is not in London. He has been commuting between Timmins, Toronto, and Montreal, endeavoring to conclude the agreement with the Ontario Government about the Hollinger waterpower rights on the Abitibi River.

Though it is taken for granted that every mine has its price, the Hollinger cash and ore-reserve position, and current developments, do not necessitate haste in disposing of what is increasing in value. To quote a director: "The mine is a picture show at depth." Manager Brigham has said that "we have never gone after what looked as though it would make ore, without getting twice as much as we expected." This is a broad generalization. Sustaining it is the vertical extension of the remarkable No. 1 vein, which largely sustained production in the earlier years.

Good fortune seems to continue to wait upon Hollinger owners; it is understood that their acquisition of the Schumacher has been attended by the finding of two veins on the 800 level, 15 and 10 ft. wide, and averaging better than ½ oz. gold. Even in the upper section of the Schumacher, there is more than the original owners located. So rich is the ore in one Acme vein that a watch-on-watch vigil is kept. High-grading would be possible and profitable. Knowledge of conditions, no doubt, may have influenced the National Mining and the New Consolidated

Goldfields corporations in sponsoring in London the recent flotation in connection with the Rochester Veteran claim, adjoining the Timmins town site. Grant Morden and others, of London and New York, held the option to purchase the Rochester Veteran claim, after the Nipissing management had turned it down. To have Mr. Joel and colleagues—within and without the National Mining Corporation—secure control of Hollinger, would give London a decisive interest in Porcupine. Yet it is certain mere control of Hollinger is not to be had. Otherwise London continues along the side-lines. It has entertained so many propositions in northern Ontario that it is not improbable that the use of Mr. Joel's name in the manner indicated may have a double purpose. Plausibility is given to it by the previous identification of Mr. Brigham with the management of Jagersfontein diamond mine, with which the Joel-Barnato group is influential.

Already an advance guard of adventurers has reached the Labrador placer fields, so extensively exploited in the daily papers. Those better informed will not risk it until June. Meanwhile a great deal of money and a large following among the public cannot prove or disprove much that was claimed for the discoveries. One company—holding the largest areas—has made no statement other than that gravels at various points yielded exceptionally. What funds are in hand will be devoted to a thorough investigation by men of experience from California and New Zealand. Another company, some of the principals in which indulged in extravagant forecasts of the possibilities, is not dwelling in harmony, because of recent information. The most unfortunate feature is that alluring advertising drew so much money from New England and the Eastern Provinces of Canada that there is likely to be trouble when it is realized that a great deal of ground was selected at random from maps. Of one of the principals in a most active company, an officer of that company, in a letter declares to one of the discoverers: "Your name ought not to be associated with him. He should be associated with someone who is serving a life sentence." It would seem, therefore, as if there are rifts in the lute.

Trail Ore Receipts

The Consolidated Mining and Smelting Company of Canada received at its Trail plant during the period May 1 to May 7 the following consignments of ore:

Name of Mine	*Locality*	*Tons*
Black Rock	Northport, Wash.	40
Bell	Beaverdell, B. C.	47
Hewitt	Silverton, B. C.	41
Knobhill	Republic, Wash.	211
Last Chance	Republic, Wash.	441
Quilip	Republic, Wash.	213
Surprise	Republic, Wash.	51
Silversmith (zinc)	Sandon, B. C.	95
Silversmith (lead)	Sandon, B. C.	126
Standard	Silverton, B. C.	172
Company mines		10,082
		11,519

ONTARIO

Keeley Will Increase Mill Capacity

The management of the Keeley mine, of South Lorrain, now one of the largest silver producers in Canada, has decided to increase mill capacity from 60 to 125 tons a day. The present production is at the rate of 200,000 oz. a month, but this could be materially increased if it were considered advisable to do so. In addition to increasing the capacity of the mill, the company is planning a large amount of development work and will start sinking immediately to the 550 level.

New Work at Porcupine

The Coniagas, at Porcupine, is installing a large plant on the Newray property, where it expects to do a large amount of work. A new electric mining plant will be installed, and it is expected that the shaft will be carried to 1,000 ft. At the Goldale property, which is under option to the Kerr Lake, sinking has been started from the 500 to the 1,000 level. The Porcupine-Davidson has purchased mining machinery for the new incline shaft, which will be sunk to 1,000 ft. this year. The company is also clearing a site for a 500-ton mill, and it is expected that construction will start this summer. The Vipond is getting ready to start milling 75 tons per day.

BRITISH COLUMBIA

Duthie Will Develop Smithers Properties

J. F. Duthie recently has concluded an examination of his group of properties on Hudson Bay Mountain, near Smithers, and has laid out a plan for development to be done during the next few months. Steam is to replace the present gasoline-driven compressor plant, and a ten-drill compressor has been shipped from Chicago and two 100-hp. boilers will be shipped from Vancouver within the next few days. There is an ample supply of wood on the property, and the change from gasoline to steam should effect a considerable saving. Work on the two tunnels at the Henderson group, from which seven cars of high-grade ore have already been shipped to Trail since the beginning of the year, is to be continued, and, as soon as the new machinery has been set up, the tunnel on the Mamie group will be extended another 1,000 ft. This extension, it is expected, should cut at depth the rich ore that has been opened on the surface. A tunnel is to be started on the Hanna group, which was added to the consolidation last year, and a good deal of surface exploration will be done. A gang of men are working on the road between the mine and Smithers, with a view to facilitating ore transportation. About thirty men have been employed steadily through the winter, and as soon as the new machinery arrives the force will be doubled. In future the consolidation will be known as the Duthie Mines, Ltd.

Federal Starts Sinking

The Federal Mining & Smelting Co. has taken a large quantity of supplies to the Jefferson group, on Dome Mountain, north of Telkwa, which it acquired recently, and has established a camp at the property. A boiler, compressor, and drills are on their way to the property and are expected at Telkwa daily. A good trail through the snow has been broken between Telkwa and Dome Mountain, a distance of 18 miles. Sinking by hand has been started pending the setting up of the new plant.

MEXICO

Pedrazzini Paid 18 Per Cent in 1922

At a meeting of the stockholders of the Pedrazzini Mining Co., held recently in Paris, a detailed report was rendered by Jean Pedrazzini, president, and M. Berrogain, vice-president. Both of these men recently visited the mines of the company, which are situated about 45 miles from Cananea, in the State of Sonora.

In 1922 a dividend of 18 per cent was paid to the shareholders and a bonus of 37,879 fr. for the first issue of stock for organization. During that year 1,054,999 oz. of silver and 5,519.67 oz. of gold were produced. About 4 100 ft. of work was performed, principally between the 800 and 1,000 levels. An automobile road has been completed from the mines to Cananea, the nearest railroad station, and the ores are now being handled by trucks instead of pack animals.

A high-tension power line is nearing completion from Cananea, and electric machinery has been ordered and will soon be on the ground. As soon as this machinery is installed, a large additional force of miners will be employed in carrying on development work. Ore is being extracted regularly.

La Fe Mill Nears Completion

La Fe Mining Co. is gradually increasing activity. The repairs and enlargement of the mills are nearing completion, and the mines are being extensively developed. Large bodies of ore have been blocked out.

The mines owned by this company are the Rio Tinto, composed of 30 claims; the Rio Seco, 20 claims; La Fe, 2, and Anexas a La Fe, 4 claims. They are situated in the Guadalupe camp about five miles southeast of Zacatecas. The station of Guadalupe is connected with the main line at Zacatecas by a narrow-gage railroad. These properties were acquired in 1905 by A. Goerz & Co., of London. In 1911, the La Fe Mining Co., Ltd., was formed in that city with English capital. A power plant and mill for treating the ores were completed, and operations were begun, but the company was obliged to suspend in 1914 due to revolutionary activities, and did not resume until last year.

The ores are of silver and lead, with high iron content. Equipment includes modern hoists, Ingersoll-Rand drills and Prescott pumps.

ARIZONA

Phelps Dodge Industrial Relations Work Proves Helpful

During the year 1922, the Phelps Dodge Corporation, Copper Queen Branch, whose operations are at Bisbee and Douglas, granted twenty-one additional pensions to retired employees. This makes the total number of men on pension ninety-four. This company also maintains an Employees' Benefit Association, in which the percentage of membership to total number of men employed, exclusive of Mexicans, is 82.8. The corporation contributes $15,000 per year toward the cost of this blanket insurance for its men, and the dues paid by the employees amounts to 2 per cent, computed on rate of pay for total days in calendar month up to the maximum pay of $150. The policies cover both accident and sick benefits, paying $1,500 upon death and providing payment of half wages for the period of sickness or disability due to accidents. This insures the men of half wages even if disabled for only a few days, for the state compensation laws provide only payment of half wages if the period of disability is two weeks or longer. The Employees' Benefit Association is governed by a board of trustees composed of three men appointed by the company and four members appointed by the men. The Copper Queen also has an employees governing board made up of a House and Senate and modeled after the national government. This plan has been a source of satisfaction to both the men and the company and has proved its worth in amicably adjusting many differences arising in the operation of such an enterprize.

New Operations at Bisbee

Many small companies in the Bisbee district that have been idle for years are now either being started or are planning early resumption of development. The East Warren Co. has contracted for the sinking of the first 100 ft. of the shaft on its property, which is three miles southeast of Warren. This company, owns twenty-five claims adjoining the Copper Glance property.

The Home Town Development Co., owning twenty-six patented claims in the Wood Canyon section, will soon start development. Considerable ore of excellent grade was shipped from numerous tunnels on these claims in the old days.

The Shattuck-Arizona Co. is now shipping 100 tons of copper ore and 100 tons of lead ore per day. About 125 men are employed on development, mining, and repairs.

New Copper Extraction Process?

Joseph Irving, at Phoenix, is working to devise a process for the treatment of copper ore that contains an appreciable amount of the oxide metal, which, under ordinary mill treatment, is lost in the tailing. Mr. Irving suggests preliminary leaching, the separation of the dissolved copper solution and slime by classification and the subsequent treatment of the unattacked sulphide portion by other methods. Thickeners are used for the separation of the solution associated with the slime, and the metal is precipitated as cement copper. The tail liquor from the precipitation vats is pumped back to the head of the mill, to be mixed with fresh ore, thus completing the cycle.

Ivanhoe Drifts on 200 Level

The Ivanhoe Copper Co., which started operations last November, has sunk 200 ft. of shaft and is now drifting on the 200 level. This company owns 220 acres of patented ground extending east from the town of Warren. The work under way is with the object of exploring beneath a large siliceous outcrop. At the Boras mine several years ago ore was found below a similar outcrop. Both of these mines are under the management of M. J. Elsing, with H. Hendrickson as superintendent.

Arizona Dearborn Unwatered

Preparations are being made to unwater the shaft of the Arizona Dearborn company's shaft in the Jerome district. Walter Ornsby, superintendent, and C. H. James, engineer, have gone to the camp, and a crew of men will be employed in getting the buildings and surface equipment in condition. After the shaft is unwatered, an examination is to be made of the workings and a program of development is to be decided upon—likely, the deepening of the shaft.

NEW MEXICO

Wampoo Mine Leased

The old Wampoo mine, about 25 miles northeast of Duncan, owned by Steve Corley, has been leased to Hill & Hill, of Silver City. Lead-silver ore is being hauled to Sheldon Station, on the E. P. & S. W., for shipment to the El Paso smelter. This property was sold several years ago under foreclosure for debts of the Mayflower Mining Co. W. B. Deval is president. Mr. Corley, who had held it for nearly thirty years, succeeded in getting it back.

Fluorspar Properties Ship

Work on the old Sadler fluorspar mine, near Deming, recently purchased by the Fluorspar Distributors, Inc., of Denver, was started May 1. Carl Schaber will have general supervision, with Mike Quarrels in direct charge. This company is also pushing production on the Tortuga property at Las Cruces. It is the largest producer of spar in the southwest.

MONTANA

Davis-Daly Operations Interrupted

An explosion last week in the cylinders of the hoisting engine at the Colorado mine of the Davis-Daly company at Butte completely wrecked the engine room and badly disabled the engine. The mine will be shut down for several days.

UTAH

Utah-Apex Declares a 50c. Dividend—Mill Approaching Completion

The expected dividend of the Utah-Apex company at Bingham has been declared, payable June 15. The usual quarterly rate of 25c. a share (after an intermission of several years, owing to litigation) is resumed and 25c. added, making 50c. per share. The amount will be $264,100, bringing the total dividends paid by the company to $1,518,575. The Utah-Apex, finally winning its litigation with the Utah Consolidated company, has recently been paid damages, with interest, amounting to $1,276,282. The mine has a capacity for handling 1,000 tons of ore daily, and there are large available reserves of ore.

The Leadville orebody, which figured so importantly in the lawsuit, now released to the Apex, is large. Production is from the 1,800 level, and drifts are being driven on the 2,000 level. Much exploration is being done on the lower levels. The work of remodeling the mill is approaching completion. A recovery of 95 to 97 per cent is being made. The mill is treating 350 tons of ore a day, but this tonnage should be improved soon.

New Ore in Columbus Con. at Alta

The Wasatch Mines Co., which has for some time been driving a drain and operating tunnel, in order to cut the downward extension of orebodies in the old Columbus Consolidated and Falstaff ground at Alta, is meeting with encouraging results. Last year the company shipped 5,000 tons of ore from the Columbus No. 5 orebody and mined the tunnel level upward to the 400 level, the latter representing the greatest depth attained by earlier work. Now a crosscut from a winze sunk 70 ft. below the tunnel level has opened copper ore, which is expected to bring $35 to $45 per ton, after payment of smelting, freight, and haulage charges. The new find has so far been followed 130 ft. in a westerly direction; it varies from three to eight feet in width over this distance.

Two Alta Properties to Be Operated Under One Management

The West Toledo and the Columbus-Rexall, two Alta properties, both of which have recently had promising strikes, are being brought together by the purchase of a large block of Columbus-Rexall stock by the controlling interest in the West Toledo. The West Toledo has become a shipper recently, and the Columbus-Rexall has been a shipper for some time. During 1922, Columbus-Rexall produced 2,898 tons of silver-lead ore, which sold for $107,000, with costs at $72,357, and net proceeds of $34,642, according to figures handed to the state board of equalization for taxation purposes. The ore in the West Toledo appears to be making into Columbus-Rexall ground, and for this reason the proposed purchase seems advantageous.

Utah Ore Shipments

Shipments from Eureka for the week ended May 6 amounted to 207 cars, compared with 215 cars the week preceding. Chief Consolidated shipped 100 cars; Tintic Standard, 32; Dragon, 14; Iron Blossom, 13; Colorado, 11; Eagle & Blue Bell, 10; Victoria, 8; Iron King, 7; Swansea, 3; Mammoth, 2; American Star, 2; Yankee, 1; Tintic Milling Co., 1; Bullion Beck, 1; Colo. (Larsen & Linbeck Lease), 1.

Shipments from Park City amounted to 5,674 tons, compared with 5,567 tons the week preceding. Shippers were: Silver King Coalition, 2,050 tons; Park-Utah, 1,853 tons; Park City Mining & Smelting, 1,275; Ontario, 486.

NEVADA

Simon Silver Lead Mill Handles 225 Tons

Changes and additions to the flotation plant of the Simon Silver Lead Mines Co. at Mina were completed in April, and the mill has been tried out and is in operation. It now has a capacity of 225 tons per day, compared to former capacity of 180 tons per day. The mine is in excellent condition, connections having been made to the old shaft workings. New developments in the orebody recently discovered south of the new shaft are satisfactory. It is said that this ore contains a less percentage of zinc and silghtly higher lead and silver content than the average in the mine.

Activity at Tolicha

The Tolicha district, about 40 miles south of Goldfield, continues to attract attention. The group of claims under option to Charles E. Knox and associates is being superficially developed by open cuts, shallow shafts, and short tunnels. A vertical shaft is being sunk on a group to the north, under option to Dave Lewellan and associates, and work on a small scale is being accomplished on several adjoining groups of claims. The country is located for miles. The district contains wide surface showings with places containing high-grade values. A railroad siding at Ancram is being seriously talked of, and as soon as this siding is completed trial ore shipments will begin. Ancram is 16 miles from Tolicha.

Bullion Output Increased

Tonopah bullion shipments, representing clean-up of operations for the latter half of April, were a little above normal and as follows: Tonopah Belmont, $119,880; Tonopah Extension, $80,000; West End, $77,900; and Tonopah Mining Co., $60,000. In addition a $9,000 shipment of gold bullion from the Manhattan White Caps passed through Tonopah early in May.

Gypsy Queen Reopened

The Montana Tonopah Co. Reorganized is retimbering and repairing the Gypsy Queen shaft. Timbers were in bad shape for the first 250 ft., but below that point and to the 550 level the timbers are in fair condition and should improve as depth is attained, so that progress will be better. The shaft is 1,550 ft. deep, and present plan is to sink to the 2,200 level before crosscutting.

Development at Lynn Big Six

Developments in the Lynn Big Six mine, near Carlin, are encouraging, according to R. Mabey Holt. In sinking a winze in the main tunnel from the 200 to the 300 level on the No. 2 vein from 2 to 3 ft. of ore assaying from $23 to $61 a ton in gold has been followed.

Inasmuch as work has been carried in this winze to as great a depth as the laws of Nevada will allow with the present equipment, a station has been cut for the installation of a hoist.

As soon as this equipment can be installed, the company plans to sink the winze to water level, estimated to be 200 ft. below its present depth on the dip of the vein.

A raise from the main tunnel level on the same shoot has progressed 72 ft. on 2½ ft. of ore which will average $30 a ton in gold.

At the same time a drift is being run north in what is called the "Big" vein of the No. 2 systems that consists of two branches—the "Big" vein and the "Rich" vein. These branches are separated by a rib of rhyolite about 12 ft. thick.

The "Big" vein ranges from 10 to 30 ft. thick. Considerable of the vein matter is good mill ore. It is believed that when the winze in No. 2 vein reaches water level, by crosscutting to the "Big" vein large orebodies can be opened up.

When the north drift on the 200 has been advanced somewhat farther, a crosscut to the "Rich" vein, in which the winze and raise has been made, will be started.

IDAHO

Asbestos Property Ships

Spokane business men represented by W. McMahon are reported purchasers of the property of the Kamiah Asbestos Co., operating 80 acres of asbestos land near Kamiah, Idaho, under lease from the state. The latter receives 25c. per acre and 2 per cent of the gross revenues from sales. A carload of the product has been shipped to the Hawkeye Felstone Co., of Spokane, to be used in a magnesite composition flooring.

WASHINGTON

Last Chance Active

The Cornucopia Mines Co. is again producing gold from its Last Chance property, which has been developed at great depth by means of a long crosscut tunnel.

The Sumpter Valley gold dredges are steadily producing from the gravel deposits, and have been in operation for several years. The outlook for mining activity in eastern Oregon appears bright for the coming season.

MICHIGAN

Lake Copper Sold to Mid-June

The first copper to move out of the Michigan district by boat this season was taken by the steamer "Superior" of the Great Lakes Transit Co., which loaded 3,000,000 lb. of Calumet & Hecla metal at the Torch Lake smelter on May 5. There is no accumulation of copper on the docks of any of the smelters as is usual at this time of the year, shipments by rail all winter having cleaned up surplus and current production. It is estimated that fully 13,000,000 lb. was moved in April. The companies are sold up for May and the early part of June, but to date orders for late June and July delivery are scarce, buyers apparently holding off for lower prices. Demand for copper wire also has been strong, the Dollar Bay plant having shipped an estimated total of 2,000,000 lb. in April.

Electrolytic Plant Idle for Some Time to Come

It is unlikely the Calumet & Hecla electrolytic plant will again be operated for some time to come, at least until Osceola and the Osceola amygdaloid shafts of the parent company are reopened. The only Calumet & Hecla property now operating which has any appreciable amount of silver in its copper is Isle Royale, little being found in the conglomerate or in Ahmeek rock. Since suspension of the electrolytic plant, orders specifying electrolytic copper are filled at Perth Amboy, N. J., where the anodes are shipped for electrolytic treatment.

Dredge Being Erected

Calumet & Hecla will make repairs to the railroad leading to the Point Mills drydock, where the dredge for the new reclamation plant on the Tamarack conglomerate tailing deposit will be assembled. The hull of the dredge has been constructed by the Worden, Allen Co., of Milwaukee and the machinery has been turned out by the Bucyrus company, of Milwaukee.

Michigan Gets Coal

Arrival of the first coal cargoes from the lower Lakes came in the nick of time for the majority of the Michigan copper mines, as they had all but exhausted their fuel supplies. The storages at Quincy mill were depleted. Coal is moving freely into the district now, and no difficulty is expected in obtaining more than a full year's supply during the season of navigation.

Labor Situation Serious

The labor situation in the copper districts continues to cause apprehension. Although fewer men are leaving than formerly for the industrial centers, the movement to the farms has been considerable. The mines will do well to maintain operations on a 50 per cent basis. There are occasional rumors of a further wage increase, but it is stated there is no likelihood of this under 18c. copper.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
10	15.75	43.00	44.00	7.25	7.00	6.60
11	15.75	42.375	43.375	7.00@7.25	6.90	6.50@6.70
12	15.625@15.75	41.75	42.75	7.10@7.25	6.90	6.50@6.60
14	15.25 @15.75	41.25	42.25	7.10@7.25	6.875	6.40@6.50
15	15.00@15.375	41.125	41.75	7.10@7.25	6.85@6.875	6.45@6.50
16	14.875@15.25	40.75	41.375	7.15@7.25	6.875	6.50@6.60
Av.	15.490	41.708	42.583	7.183	6.902	6.538

*These prices correspond to the following quotations for copper delivered: May 10th and 11th, 16.00c.; 12th, 15.375@16.00c.; 14th, 15.50@16.00c.; 15th, 15.25@15.625c.; 16th, 15.125@15.50c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. The quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
10	68¼	69	78¾	207¾	207¾	24⅜	24⅜	30⅞	31⅛
11	67⅜	68¼	78	205	204½	25	24½	30	30½
14	65⅞	66⅝	76	199	197½	25⅛	24⅝	29¾	29⅝
15	65¾	66⅛	75	197¼	195½	25⅛	24⅝	29½	29½
16	64⅝	65½	75	192⅛	192⅝	26¼	25¼	30⅝	30⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver			May	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
10	4.60⅜	99⅝	66⅞	32⅝	14	4.62⅜	99⅝	67½	32 13/16
11	4.60¾	99⅝	66⅜	32 7/16	15	4.62⅞	99⅝	66⅞	32 9/16
12	4.61½	99⅝	66¾	32⅝	16	4.62½	99⅝	66¼	32 5/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, May 16, 1923

Another week of declining prices and meager sales must be reported, though there is an indication that a reaction is about to set in. Consumers have kept off the market so long now that it will soon be necessary for them to buy at least small lots, and the increased strength in London today in lead and zinc is encouraging. Sales of fabricated metal have without question decreased recently, but not to the extent that have sales of raw metal. In a declining market, it is only human nature for buyers to hold off as long as possible, and when the turn comes there is likely to be a scarcity of supplies for prompt delivery.

Copper

The volume of business transacted for the week has been small, with a wide divergence of quotations, depending upon the anxiety of sellers to market copper and the thoroughness with which buyers canvass the market. Yesterday and day before, business was practically at a standstill. Today, more inquiries are reported, but few have resulted in sales. The more important producers are virtually out of the market at present levels, selling only an occasional lot to regular patrons. What little business is being done is being booked by custom smelters, trading interests, and second-hands. Should a large consumer have an attractive order to place, it is almost certain that he could obtain the metal for less than 15.25c. delivered, for offers at that level were turned down yesterday. Deliveries even into 1924 might be arranged.

Export demand continues lifeless, also, with the Copper Export Association virtually off the market at prices less than 16c., c.i.f. Some sales by outside interests have been made in the last day or two at from one-quarter to one-half cent under this price.

The American Brass Co. yesterday announced important reductions, amounting to about 1.25c. per lb. in the prices of its principal products, the new basis being considered by followers of the copper market to represent one that would be logically maintained if copper sold at 15.75@16c. It is hoped that this reduction will stimulate business which will react at an early date in sufficient buying of copper to bring up the price to the level mentioned.

Lead

The official contract price of the American Smelting & Refining Co. continues at 7.25c., New York.

There is a distinct feeling that lead prices have touched bottom for the time being. This is caused by the scarcity of prompt supplies of desilverized lead and by the fact that a considerable increase in strength is apparent in the London market. In fact, the London price has reacted today to a figure which will make it unprofitable to sell European or Australian lead in this market, and the pressure that has been exerted by importers has ceased. However, during the week lead has been sold in the New York market in fair tonnages at well under the 7.25c. level of the principal interest, though almost without exception this business has been for future delivery, largely July. Those who are selling this forward metal believe that, although an upward turn is likely in the near future, the price will react to around 7c. in the summer and early fall. Sales of lead products are slowing up in some lines, though these do not include any products destined for the automobile industry. The slightly decreased orders are not yet reflected in any lessened demand for metallic lead or semi-finished lead products, and producers are still running to as near capacity as possible, as many are either behind in their orders or have less than normal stocks.

The St. Louis market has varied from

6.85 to 6.90c. most of the week, though there are not so many sellers at that level as there were last week, when prices were higher. In Chicago, lead has sold for 6.90c. in the last few days. Supplies of chemical lead in the Middle West are now ample.

Zinc

Despite the favorable showing of the zinc statistics for April, released by the American Zinc Institute, the market has declined. Stocks on hand April 1 were 10,021 tons; production, 46,867; shipments, 47,911; stocks on hand April 30, 8,976 tons. Production is taking place at a high rate, which doubtless has something to do with the failure of the market to advance. Sales were made only by forcing them at low prices. Earlier in the week zinc was sold for 6.60c. for prompt shipment and 6.45c. for shipment in June or July. The spread between prompt and future zinc is decreasing, although the greater demand is still for metal to be shipped during the summer months.

Tin

Buying here has been somewhat better, though most consumers are not taking the metal in large amounts, preferring to wait and see how much farther the decline will go. Tin for forward delivery has sold at the same prices as spot.

Arrivals of tin, in long tons: May 8th, China, 5; 9th, Java, 75; Straits, 715; 11th, Liverpool, 25; Straits, 650; 14th, Straits, 10; total so far in May, 4,235.

Gold

Gold in London: May 10th, 89s. 6d.; 11th, 89s. 5d.; 14th, 89s. 2d.; 15th, 88s. 11d.; 16th, 88s. 11d.

Foreign Exchange

On Tuesday, May 15, cable quotations on francs were 6.68c.; lire, 4.8675c.; marks, 0.0022⅜c.; and Canadian dollars, 2 per cent discount.

Silver

Without any notable feature, the market has continued on a trading basis at declining quotations. China and India have both bought and sold, and although business was quiet, the undertone for the moment appears steady.

Mexican Dollars—May 10th, 51; 11th, 50⅝; 12th, 51; 14th, 51⅛; 15th, 51; 16th, 50⅛.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 27c. per lb.; 98 per cent, 26c. London £110@£115.

Antimony — Chinese and Japanese brands, 7⅛c. W.C.C., 8c. Cookson's "C" grade, spot, 10@10½c. Chinese needle antimony, lump, nominal, 5½c. per lb. **Standard powdered needle antimony,** 200 mesh, at 6@6½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8@8½c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1@$1.10 per lb. London, 5s.@5s. 3d.

Iridium—$260@$275 per oz.

Nickel—28@31c. per lb. for 99 per cent virgin metal. London, £135 per long ton.

Palladium—$81 per oz.

Platinum — $116 per oz. London, sponge, £22.

Quicksilver—$68 per 75-lb. flask. San Francisco wires $66.65. London, £10.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium** and **Tungsten** are unchanged from prices given May 5.

Metallic Ores

Chrome Ore—Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. New Caledonian, $24@$26 per ton. Rhodesian, $20@$22.

Manganese Ore—40@45c. per long ton unit, seaport, plus duty.

Molybdenum Ore—75@85c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates plus duty.

Tungsten Ore—Wolframite, $8.25@$8.50; scheelite, $8.50@$9 per unit of WO_3, f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published May 5.

Zinc and Lead Ore Markets

Joplin, Mo., May 12—Zinc blende, per ton, high, $47.70; basis 60 per cent zinc, premium, $40; Prime Western, $37.50 @$38; fines and slimes, $37@$36; average settling price, all grades of blende, $41.42; calamine, basis 40 per cent zinc, $24@$25; average, $27.20 per ton.

Lead, high, $112.20; basis 80 per cent lead, $92.50@$87.50; average settling price, all grades of lead, $111.51 per ton.

Shipments for the week: Blende, 14,516; calamine, 87; lead, 2,528 tons. Value, all ores the week, $885,690.

Pessimism dominated the session of the Zinc Institute in St. Louis during the week. Mr. Thacher, of New Jersey Zinc Co., expressed a belief that slab zinc would return to 8c. within thirty days. The fact that stocks were reduced during April nearly 1,000 tons more than the export sales warrants an optimistic viewpoint, and the further fact that producers of sheet zinc are buying three to four times the usual tonnage of ore offers further hope.

Platteville, Wis., May 12 — Blende, basis 60 per cent zinc, $41 per ton. Lead, basis 80 per cent lead, $109 per ton. Shipments for the week: Blende, 971 tons; lead, 40 tons. Shipments for the year: Blende, 13,387; lead, 260 tons. Shipments for the week to separating plants: 2,183 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $500; No. 2, $250@$325; long spinning fibers, $135@$200; magnesia and compressed sheet fiber, $100@$150; shingle stock $65@$85; paper stock, $35@$42; cement stock, $20@$25; shorts, $9@$14—all per short ton, f.o.b. mines, Quebec, Canada.

Bauxite, Barytes, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and **Tripoli** are unchanged from the May 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb. for prompt. June, 12½c. Second half 1923, 11c.

Copper Sulphate—Large crystals, 6c.; small, 5.90c.

Potassium Sulphate, Sodium Nitrate, and **Sodium Sulphate** are unchanged from quotations of May 5.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $125 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $40@$47, f.o.b. furnace; 16@19 per cent, $39@$45.

Ferrocerium, Ferrochrome, Ferro molybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published May 5.

Metal Products

Copper Sheets—Base price, 24.25c. per lb. Wire, 19c.

Yellow Metal—Sheets, 25c. per lb.; rods, 22.5c.

Zinc Sheets—Base price, $9.20 per 100 lb., with usual discounts and extras.

Lead Sheets, and **Nickel Silver** are unchanged from the prices given in the May 5 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the May 5 prices.

The Iron Trade

Pittsburgh, May 15, 1923

The rate of steel production proves somewhat larger than recently estimated. Ingot production averaged during April a rate of 49,000,000 tons a year, and as production was increasing during the month the present rate may be taken at fully 50,000,000 tons. The rate is greater than either sellers or buyers of steel expected could be attained.

Delivery premiums have now almost disappeared, while basis prices, for forward delivery, are firm and unchanged, with no likelihood of decline in the near future.

Pig Iron—The nominal quotation of $31, Valley, on all grades, maintained since late in March, is yielding to actual facts, bessemer having sold in small lots at $30, and basic is offered by a large merchant producer at $29. Foundry and malleable continue nominal at $31. There is scarcely any buying demand at the moment.

Connellsville Coke—The market has continued softening, with spot now at $5@$5.25 for furnace and $6@$6.50 for foundry. Operators are interested in making third-quarter contracts, but consumers are not

COMPANY REPORTS

Ray Consolidated Copper Co.

Copper; Ray, Ariz.

A report of the operations of the Ray Consolidated Copper Co. for 1922 shows a loss of $433,114.36 as follows:

Operating revenue		
Copper produced—27,953,408 lb. @ 13.644 c.	$3,814,080.09	
Gold produced—383.192 oz. @ $20.00	7,663.84	
Silver produced—214.29 oz. @ 99.627 c.	213.49	
		$3,821,957.42
Operating expenses		
Mining, including mine development extinguishment	$1,357,200.65	
Ore delivery—mine to mill	258,437.23	
Milling	977,045.73	
Treatment, freight, and refining	944,571.11	
Selling expense	63,406.10	
		3,600,660.82
Profit from operations		$221,296.60
Miscellaneous income		122,417.66
Total income		$343,714.26
Charges against income		
Depreciation	$438,756.31	
Shutdown expense, etc.	338,072.31	
		776,828.62
Net loss to surplus account		$433,114.36

Surplus from Operations

Balance Dec. 31, 1921		$12,665,909.89
Loss for year (exclusive of any deduction for depletion)	$433,114.36	
Charges against surplus		
Flotation litigation settlement and additional capital stock tax	843,875.79	
		1,276,990.15
Balance Dec. 31, 1922		11,388,919.74

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

	Dec. 31, 1922	Dec. 31, 1921
Mining and milling property	$8,666,940.27	$8,656,440.27
Construction and equipment—mine, mill and railroad—less reserve for depreciation	6,471,906.87	6,959,223.74
Development of properties—net	5,990,418.62	6,040,307.44
Total for mining, milling, railroad, and development	$21,129,265.76	$21,655,971.45
Outside investments	2,150,008.52	1,660,169.15
Copper Export Association, Inc., suspense	368,413.04	478,432.22
Unadjusted debits and prepaid insurance	322,054.44	63,016.61
Materials and supplies	1,043,861.47	1,331,904.35
Accounts receivable	425,346.93	505,097.56
Metals in transit	2,357,902.55	1,497,942.54
Cash	2,002,492.11	3,293,056.86
	$29,799,344.82	$30,485,590.74

Liabilities

Capital stock of Ray Consolidated Copper Co., outstanding	$15,771,790.00	$15,771,790.00
Accounts payable	104,206.68	32,169.47
Treatment, refining, and delivery charges—not yet due	352,287.79	34,909.47
Reserve for taxes, insurance, and other expenses	461,843.32	519,459.16
Surplus from sale of securities	1,506,646.11	1,506,646.11
Surplus from operations	11,602,570.92	12,620,616.53
	$29,799,344.82	$30,485,590.74

Production amounted to 29,114,577 lb. at a cost of 12.41c. per lb. exclusive of depreciation.

Copper Range Co.

Copper; Painesdale, Mich.

A report of the operations of the Copper Range Co. for 1922 shows an operating income of $331,683.76 as follows:

29,029,474 lb. of copper produced and sold at an average of 14.225c. per lb.		$4,129,538.82
Interest		136,298.34
Atlantic Mining Co. income from rents and interest		4,585.15
Brought forward		$4,270,422.31
Mining expense, smelting, freight, sales department and all other expenses		3,264,322.96
		$1,006,099.35
Taxes paid by mining companies		306,252.55
		$699,846.80
Operating income of Copper Range R.R.	$191,094.54	
Less interest on bonds	114,000.00	
		77,094.54
		$776,941.34
Deduct one-half of net mining profit of Champion Copper Co. which belongs to the St. Mary's Mineral Land Co.		445,257.58
Operating income		$331,683.76

Balance sheet as of Dec. 31, 1922, including subsidiary mining companies, follows:

Assets

Cash		$2,002,172.51
United States Liberty Loan bonds		1,793,000.00
Copper delivered and not paid for		316,135.00
Copper on hand		806,538.14
Copper Range R.R. Co. bonds		870,000.00
Michigan Smelting Co. stock		340,000.00
Balance due from U. S. Government account railroad guaranty under the Transportation Act 1920		92,966.29
Supplies at mines	$523,112.26	
Cash at mines	88,194.25	
		611,306.51
Accounts receivable		519,808.79
Insurance prepaid		1,612.49
U. S. and short term securities		341,119.47
		$7,694,659.20

Liabilities

Current indebtedness at mines	$123,747.34	
Accounts payable	448,329.29	
		572,076.63
		$7,122,582.57
Less one-half Champion		1,360,619.03
Net excess of assets		$5,761,963.54

Production amounted to 19,237,571 lb. of copper at a cost of 13.22c. per lb. Price received was 13.43c. per lb.

Chino Copper Co.

Copper; Hurley, N. M.

A report of the operations of the Chino Copper Co. for 1922 shows a loss of $848,785.57, according to the following account:

Operating revenue		
Copper produced, 28,406,314 lb. @ 13.636c.	$3,873,403.68	
Gold produced, 478.948 oz. @ $20	9,578.96	
		$3,882,982.64
Operating expenses		
Mining, including stripping expense	$1,082,163.74	
Ore delivery—mine to mill	154,198.10	
Milling	1,305,337.32	
Treatment, freight, and refining	834,160.08	
Selling expense	61,552.54	
		$3,437,411.78
Profit from operations		$455,570.86
Net miscellaneous income		247,415.66
Total income		$692,986.52
Charges against income		
Depreciation for year	$483,685.15	
Loss on property retired, replaced, superseded, or abandoned	13,229.11	
Flotation litigation settlement and shutdown expense	1,044,857.83	
		$1,541,772.09
Net loss to surplus account		$848,785.57

Surplus From Operations

Balance, Dec. 31, 1921	$12,575,703.68
Loss for year (exclusive of any deduction for depletion)	848,785.57
Balance Dec. 31, 1922	$11,726,918.11

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Chino Copper Co. (Continued)

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Dec. 31, 1922		
Original purchase price of property	$1,802,795.62	
Mining property purchased	347,715.99	
		$2,150,511.61
Expenditure for construction and equipment	$10,770,673.10	
Less reserve for deprecation	3,653,824.91	
		7,116,848.19
Development of properties		1,179,964.13
Net expenditures		$10,447,323.93
Investments		2,339,829.84
Deferred charges to operations		
Stripping expense	$4,802,729.11	
Ore stored at mine	520,687.61	
		$5,323,416.72
Bond deposit account		75,000.00
Copper Export Association, Inc., suspense		337,575.16
Materials and supplies on hand		1,317,192.66
Accounts receivable and prepaid insurance		68,473.89
Copper on hand and in transit	$2,216,490.15	
Ore at mill	8,477.04	
Leaching ore and precipitates	71,102.44	
		2,296,069.63
Cash	$97,073.35	
Cash due for copper deliveries	324,070.32	
		$421,143.67
		$22,626,025.50

Liabilities

Capital stock	$4,349,900.00
Accounts payable	440,561.83
Loans and bills payable	1,264,611.81
Accrued taxes and insurance	1,513,699.79
Treatment, refining and delivery charges, not yet due	335,081.19
Surplus from sale of securities	2,995,252.77
Surplus from operations	11,726,918.11
	$22,626,025.50

Production amounted to 28,406,314 lb. of copper in the nine months of operation, at an average cost of 11.2c. per lb.

Miami Copper Co.

Copper; Miami, Ariz.

A report of the operations of the Miami Copper Co. for 1922 shows a net balance of $1,973,444.34 as follows:

Concentrates—67,434,534 lb. @	$0.0569069	$3,837,491.14
General mine expenses	.0097038	654,371.66
Freight on concentrates	.0063872	430,718.12
Smelting, refining, and freight on pig copper	.0174334	1,175,617.66
Legal expense	.0013197	88,998.44
New York office expense and taxes	.0031481	212,291.76
Selling expenses, freight, discount and commission	.0027067	182,513.19
	$0.0976058	$6,582,001.97
Less rentals, sales of power and water	.0003031	20,442.78
	$0.0973027	$6,561,559.19
Balance carried down		2,205,700.87
		$8,767,260.06
Deliveries of copper during year 63,245,465 lb. @ .13500		8,538,702.95
Less on hand Jan. 1, 1922 18,228,004 lb. @ .11550		2,105,150.18
45,017,461 lb.		$6,433,552.77
Plus on hand Dec. 31, 1922		
Refined copper sold 3,691,557 lb. @ $0.1386039	$511,664.03	
In process 18,725,516 lb. @ .0973027	1,822,043.26	
		2,333,707.29
67,434,534 lb.		$8,767,260.06

Profit-and-Loss Account

To depreciation charged off during year		$404,600.63
Balance carried to balance sheet		1,973,444.34
		$2,378,044.97
Balance brought down		2,205,700.87
Interest		141,474.17
Difference in value of securities		30,869.93
		$2,378,044.97

Assets

Mines and mining claims, ranches		$26,507,919.58
Mine development	$878,430.22	
Shaft No. 5 development	212,024.61	
		1,090,454.83
Construction and equipment		3,320,466.94
Ore and metals on hand		2,360,262.67
Sundry materials and supplies		754,273.31
Prepaid taxes and insurance		25,212.01
Cash		905,209.49
Accounts receivable		204,595.55
Sundry investments and securities		3,815,365.17
		$38,983,759.55

Liabilities

Capital stock			
Authorized 800,000 shares @ $5			$4,000,000.00
Issued 747,114 shares @ $5			$3,735,570.00
Accounts payable			1,609,713.87
Reserve for ore depletion			16,367,881.79
Surplus account			
Paid in surplus—balance Jan. 1, 1922		$20,553,334.99	
Less dividends No. 38 to 41, inclusive		1,494,228.00	
		$19,059,106.99	
Earned surplus—balance Jan. 1, 1922	$975,832.70		
Adjustment relating to previous periods	647,220.84		
Depletion for year 1922	2,138,903.90		
	$3,761,957.44		
Transferred from profit and loss account	1,973,444.34		
		1,788,513.10	
			17,270,593.89
			$38,983,759.55

Production of refined copper was 67,454,447 lb. from 2,183,020 tons of ore.

Dolores Esperanza Corporation, Mexico

Gold, Silver; Chihuahua and Sonora, Mexico

A report of the operations of the Dolores Esperanza Corporation for 1922 shows a profit of $260,405.26 as follows:

Operating revenue (Dolores)		
Bullion production		
Gold—12,006.1 oz.		$246,211.93
Silver—1,127,615 oz.		761,155.07
Sundry rents		16,655.19
		$1,024,022.19
Non-operating revenue—interest		9,000.51
		$1,033,022.70
Operating expenses (Dolores)		
Mining	$264,057.12	
Milling and cyaniding	238,686.33	
General expense	88,177.41	
Bullion marketing	126,713.69	
	$717,634.55	
Non-operating expense		
La Dura	10,040.62	
Other properties	44,942.27	
		772,617.44
Profit carried to surplus		$260,405.26

Consolidated Surplus Account as at Dec. 31, 1922

Surplus as at Dec. 31, 1921		$17,971.66
Add profit for year ended Dec. 31, 1922		260,405.26
		$278,376.92
Deduct		
Development work on property	$92,377.04	
Depreciation	32,574.39	
Dividends paid and declared	131,030.93	
		255,982.36
Surplus as at Dec. 31, 1922		$22,394.56

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Property account		
Mines, mining claims, plant and equipment (book value)		$913,097.21
Construction expenditures		
Dolores power plant, mill and cyanide plant	$647,115.01	
Mine rehabilitation	57,223.60	
		704,338.61
		$1,617,435.82
Deferred charges to future operations		2,851.86
Claims against Mexican Government		138,104.04
Concentrates stored in La Dura mine		148,073.31
Current assets		
Materials, supplies and unused equipment	$183,102.21	
Accounts receivable	4,017.71	
Bullion in transit and on hand	82,282.63	
Accrued interest	2,348.38	
U. S. Government bonds, par value	175,000.00	
Cash in bank and on hand	130,908.31	
		577,659.24
		$2,484,124.27

Liabilities

Capital stock			
Authorized 1,000,000 shares of $2 each		$2,000,000.00	
Issued and outstanding, including scrip			$1,728,175.20
Equity of minority holders in capital stock (at par) of subsidiary companies:			
Dolores Mines Co.		$18,900.00	
El Rayo Mines Co.		3,666.00	
Consuelo Mining, Milling & Power Co.		600,000.00	
			622,566.00
Current liabilities			110,988.51
Surplus			22,394.56
			$2,484,124.27

Tonopah Belmont Development Co.

Silver; Nevada

A report of the operations of the Tonopah Belmont Development Co. for 1922 shows a net income of $458,077.73, according to the following account:

	1922	1921
Gross value of production	$1,390,902.88	$1,793,660.17
Losses in treatment	75,346.01	147,701.62
Net values realized	$1,315,556.87	$1,645,958.55
Operating expenses	984,931.44	1,153,964.49
Net earnings mine and Tonopah mill	$330,625.43	$491,994.06
Net earnings of other plants	125,006.62	23,856.99
Total net earnings from operation	$455,632.05	$515,851.05
Other income	(a) 64,422.11	(a) 56,149.58
Gross income	$520,054.16	$572,000.63
Administration, exploration, taxes, etc	(b) 61,976.43	(c) 183,220.23
Net profit	$458,077.73	$388,780.40

(a) Includes dividends from Belmont Surf Inlet Mines, Ltd.
(b) Includes $22,280.02 depreciation, etc., shown on income account.
(c) Includes $130,750.29 expenses and losses occasioned by labor strike.

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Property		
Mines and mining claims	$1,568,213.88	
Shafts, buildings and machinery	34,492.58	
Millers mill	50,000.00	
Tonopah mill	91,942.97	
Re-treatment plant for sweepings	5,000.00	
		$1,749,649.43
Investments		
Belmont Surf Inlet Mines, Ltd	$1,292,352.94	
Belmont Shawmut Mining Co	878,404.19	
Belmont Wagner Mining Co	896,900.54	
Esmeralda Power Co	5,831.25	
Tonopah Divide Mercantile Co	10,650.00	
Tonopah Mines Hospital Association	1,325.00	
Buckeye Belmont lease	27,012.66	
Option on mining property	2,017.55	
		3,114,494.13
Secured loan—Jim Butler Tonopah Mining Co		83,291.15
Available assets	$763,316.39	
		$5,710,751.10

Liabilities

Capital stock		
1,500,000 shares of $1 each fully issued		$1,500,000.00
Current liabilities		123,049.41
Property reserve account (revaluation)		2,989,040.84
Surplus		
Balance of surplus and undivided profits up to Dec. 31, 1921	$1,179,565.02	
Net income for the year 1922	458,077.73	
	$1,637,642.75	
Deduct		
Charge for depletion	$238,081.90	
Dividends paid	300,000.00	538,981.90 1,098,660.65
		$5,710,751.10

Production amounted to 27,952.65 oz. of gold and 2,055,471 oz. of silver.

Belmont Surf Inlet Mines, Ltd.

Gold, Silver; British Columbia

A report of the operations of the Belmont Surf Inlet Mines, Ltd., for 1922, shows a net income of $55,047.92:

Credits

Values realized	$663,265.12	

Debits

Mining	$409,509.32	
Milling	125,980.61	
Loading	16,918.07	
	552,408.00	
		$110,857.12
Difference in exchange and miscellaneous income		17,628.48
		$128,485.60
Loss on conduct of bunk house, etc	$12,557.99	
Less rents and discounts	5,534.42	
	$7,023.57	
Administration expenses	8,759.08	
		15,782.65
Operating profit for the year 1922		$112,702.95
Depreciation		
Mill, buildings and machinery, and tug		57,655.03
Net income for the year 1922		$55,047.92

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Property		
Mines and mining claims		$1,924,110.33
Mill, buildings and machinery		251,078.22
Launches and tug		26,881.12
Brought forward		$2,202,069.67
Investment		
Surf Inlet Power Co., Ltd		200,000.00
Deferred accounts		12,579.53
Available assets		279,056.99
		$2,693,706.19

Liabilities

Capital stock			
2,500,000 shares of $1 each, fully paid			$2,500,000.00
Current liabilities			35,155.14
Reserve for dominion income tax			1,000.00
Surplus			
Balance as at Dec. 31, 1921		$157,034.75	
Net income 1922	$55,047.92		
Less sum reserved for dominion income tax	1,000.00		
		54,047.92	
		$211,082.67	
Add provincial income tax reserved but not used		9,061.51	
		$220,144.18	
Less adjustments of prior year Accounts	$93.13		
Dividend to shareholders	62,500.00		
		62,593.13	
			$157,551.05
			$2,693,706.19

Production amounted to 9,642.39 dry tons of concentrates, containing 35,014.93 oz. of gold, 17,105.85 oz. of silver and 697,058 lb. of copper.

Copper Export Association

Murry and Simon Guggenheim have resigned as directors of the Copper Export Association and Stephen Birch, president of Kennecott Copper Corporation, and John K. MacGowan, vice-president of Braden Copper Co., took their places to fill the remainder of their unexpired terms as directors and were elected to take their places on the different committees for the ensuing year, with other members of the various committees the same as heretofore.

Retirement of the Guggenheims does not have any significance, as their resignation was due simply to feeling that it would be better to have two of their executives upon the board in dealing with these technical matters than to have the places filled by themselves.

Exports of Copper, Lead, and Zinc, March, 1923 and 1922

	March, 1922	March, 1923
Copper		
Ores, concentrates and matte, regulus (copper content)	.....	134,400
Copper and manufactures of (total)	81,571,522	66,988,345
Refined, in ingots and bars	72,393,485	57,185,756
Exported to		
Belgium	3,353,514	6,500,732
France	10,227,165	10,990,961
Germany	26,357,425	17,062,928
Italy	3,642,817	4,044,758
Netherlands	2,746,519	448,169
Spain	1,526,812	291,857
Sweden	1,143,374	1,511,681
United Kingdom	4,713,226	9,125,539
Canada	99,213	1,399,942
China	8,971,207	3,617,600
Japan	8,848,079	1,780,484
Other countries	764,134	411,105
Old and scrap	273,525	169,440
Composition metal, copper chief value	144,001	17,907
Pipes and tubes	127,537	135,785
Plates and sheets	1,438,667	724,648
Wire except insulated	1,344,995	521,337
Insulated wire and cable	554,952	1,839,215
Lead		
Pigs and bars		
From domestic ore	167,199	328,794
From foreign ore	11,170,618	3,502,296
Exported to:		
France	2,464,953	896,284
Germany	4,100,634	.....
Netherlands	1,680,682	224,080
United Kingdom	1,904,670	1,924,062
Other Europe	.....	1,100
Argentina	448,000	224,000
Brazil	526,879	469,456
Other countries	211,999	92,108
Other lead manufactures	582,925	537,416
Zinc		
Dross	635,195	1,458,345
Zinc		
From domestic ore	6,668,357	11,209,008
From foreign ore	784,000	560,000
Total zinc slabs and blocks		
Exported to		
Belgium	.....	224,056
France	4,483,828	649,666
United Kingdom	1,654,325	10,695,598
Canada	167,534	101,151
Japan	1,030,525	.....
Other countries	116,145	98,537
In sheets and strips	391,568	652,533
Zinc dust	269,825	466,121
Other zinc manufactures	53,615	118,054

MINING STOCKS

Week Ended May 12, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	75½	71	72	Mar. 23, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2⅛	1⅞	2		
Alloues	Boston	24½	24	24	Mar. '19	1.00
Anaconda	New York	47⅛	45⅜	46	Apr. '23, Q	0.75
Arcadian Consol.	Boston	2½	2½	2½		
Ariz. Com'l.	Boston	11⅛	10⅜	10⅜	Oct. '18, Q	0.50
Calaveras	N. Y. Curb	3⅜	2⅜	2⅜		
Calumet & Arizona	Boston	56¾	55½	55½	Mar. '23,	1.00
Calumet & Hecla	Boston	391	376	376	Mar. '23, Q	7.00
Centennial	Boston	10	10	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	45½	43⅛	43⅜	May '23,	1.00
Chile Copper	New York	29⅛	29⅛	27⅛	Mar. 23,	0.62
Chino	New York	25⅜	23⅞	23⅞	Sept. '20, Q	0.37
Con. Coppermines	N. Y. Curb	3⅛	2⅞	3		
Copper Range	Boston	38	36	36½	May '23, Q	1.00
Crystal Copper	Boston Curb	1⅛	1⅛	1 1/16		
Davis-Daly	Boston	3½	3½	3½	Mar. '20, Q	0.25
East Butte	Boston	8	7	7	Dec. '19, A	0.50
First National	Boston Curb	60	45	45	Feb. '19, SA	0.15
Franklin	Boston	1½	1½	1½		
Gadsden Copper	N. Y. Curb	*73	*65	*73		
Granby Consol.	New York	27½	25	25	May '19, Q	1.25
Greene-Cananea	New York	25⅞	25	25	Nov. '20, Q	0.50
Hancock	Boston			3		
Howe Sound	N. Y. Curb	3⅛	3	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	35⅝	34	34½	Apr. '23, Q	0.50
Iron Cap	Boston Curb	7⅛	7	7	May 23, K	0.15
Isle Royale	Boston	25	24	25	Mar. '23, Q	0.50
Kennecott	New York	45	35	38	Apr. '23, Q	0.75
Keweenaw	Boston	1⅛	1⅛	1⅛		
Lake Copper	Boston	3¼	3¼	3¼		
Magma Copper	New York	33¼	31	32½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2⅛	2	2⅛		
Mass Consolidated	Boston	2⅛	2	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	28	27⅛	27⅛	Apr. '23, Q	0.50
Michigan	Boston			1		
Mohawk	Boston	55⅛	53¼	54⅛	Mar. '23, Q	1.00
Mother Lode Coa.	New York	10⅜	9⅞	10	Mar. '23, K	0.50
Nevada Consol.	New York	14¼	13⅜	14⅜	Sept. '20, Q	0.25
New Cornelia	Boston	19	18	18⅛	Feb. '23, Q	0.25
North Butte	Boston	9	8⅛	8⅛	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*73	*65	*68		
Old Dominion	Boston	25⅜	25	25	Dec. '18, Q	1.00
Osceola	Boston	36	34	35	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†190	†182		Apr. '23, Q	1.00
Quincy	Boston	38⅛	36⅝	36⅛	Mar '20, Q	1.00
Ray Consolidated	New York	15⅛	14⅜	14⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅛	1⅜		
St. Mary's Min. Ld.	Boston	44	43	43	Mar. '23, K	3.00
Seneca Copper	New York	8⅛	8	8⅛		
Shannon	Boston	*70	*70	*70	Nov. '17, Q	0.25
Shattuck Arizona	New York	7⅛	7	7⅛	Jan. '20, Q	0.25
South Lake	Boston			*50		
Superior & Boston	Boston	2	1⅞	1⅞		
Tenn. C. & C. cfs.	New York	10⅜	10⅛	10⅜	Apr. '23, Q	0.25
Tuolumne	Boston	*37	*33	*35	May '13,	0.10
United Verde Ex.	N. Y. Curb	35⅛	34⅛	35⅛	May '23, Q	1.00
Utah Consol.	Boston	2	1⅞	2	Sept. '18,	0.25
Utah Copper	New York	68⅛	66⅜	67	Mar. '23, Q	1.00
Utah Metal & T.	Boston	*90	*88	*88	Dec. '17,	0.30
Victoria	Boston			1⅛		
Winona	Boston	*95	*90	*90		
Wolverine	Boston	10	9	10		
NICKEL-COPPER						
Internat. Nickel	New York	14¾	14¼	14½	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	79	76¾	78½	May '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4⅜	4	4⅛		
National Lead	New York	122⅞	118½	119⅝	Mar. '23, Q	2.00
National Lead, pfd.	New York	111⅝	110	111⅜	Mar. '23, Q	1.75
St. Joseph Lead	New York	19¼	19	19	Mar. '23, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	15	13⅜	13⅜	May '20,	1.00
Am. Z. L. & S. pfd.	New York	49½	49	49½	Nov. '20, Q	1.50
Butte C. & Z.	New York	8	7⅜	7⅞	Mar. '23,	0.50
Butte & Superior	New York	28⅛	26⅛	26⅜	Mar. '23, Q	0.50
Callahan Zn-Ld	New York	8⅛	7⅛	7⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	165⅛	161	161	May '23, Q	2.00
United Zinc	N. Y. Curb	1⅛	1⅛	1⅛		
Yellow Pine	Los Angeles	*55	*55	*55	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb			5		
Batopilas Mining	New York	¼	¼	¼	Dec. '07, I	0.12½
Beaver Consol.	Toronto	45	44	44½	May '20, K	0.03
Candelaria	N. Y. Curb	*13	*11	*11		
Castle-Trethewey	Toronto	28	28	27½		
Coniagas	Toronto	2.95	2.90	2.95	May '21, Q	0.12½
Crown Reserve	Toronto	73	72	73	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	1 1/16	1	1⅛		
Kerr Lake	N. Y. Curb	2¼	2¼	2¼	Apr. '23, Q	0.12½
La Rose	Toronto	35	34½	35	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	20	19½	20	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.99	2.80	2.80	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅞	5⅜	5⅞	Apr. '23, Q	0.15
Ontario Silver	New York	7⅛	7⅛	7⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	46½	46	46½	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅜	¼	¼		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Boundary Red M.	N. Y. Curb	80	39	39		
Carson Hill	Boston	6½	5½	5½		
Cresson Consol. G.	N. Y. Curb	3¼	3⅛	3⅛	Apr. '23 Q	0.10
Dome Mines	New York	42	40	40½	Apr. '23, Q	0 50
Golden Cycle	Colo. Springs	1.07¼	1.07	1.07	Dec. '22, Q	0 02
Hollinger Consol.	Toronto	13.20	13.05	13.05	Apr. '23, M	0.05
Homestake Mining	New York	66½	66½	66½	Apr. '23, M	0.50
Kirkland Lake	Toronto	55	53	53		
Lake Shore	Toronto	3.55	3.49	3.55	Feb. '23, Q	0.02
McIntyre-Porcupine	New York	2⅛	18½	19	May '23, Q	0.25
Portland	Colo. Springs	38	37	38	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 3/16	1 3/16	1 3/16		
Tom Reed	Los Angeles	*93	*80	*80	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1⅞	2	Apr. '23, Q	0.15
Vipond Cons.	Toronto	75½	74	75		
White Caps Mining	N. Y. Curb	*7	*6	*6		
Wright-Hargreaves	Toronto	3.58	3.55	3.55	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*23	*18	*20		
Cons. Virginia	San Francisco	13½	11⅛	11⅛		
Continental Mines	N. Y. Curb	5⅛	5	5		
Dolores Esperanza	N. Y. Curb	1⅜	1 1/16	1⅜	Apr. '23	2.50
Jib Consol.	N. Y. Curb	1 1/16	1 1/16	1 1/16		
Tonopah Belmont	N. Y. Curb	1 1/16	*95	*95	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*57	*52	*56		
Tonopah Extension	N. Y. Curb	2⅜	2⅛	2⅛	Jan. '23, Q,X	0.10
Tonopah Mining	N. Y. Curb	1⅜	1 1/16	1 1/16	Apr. '23, Q	0.7½
Unity Gold	N. Y. Curb	5	4⅞	4⅞		
West End Consol.	N. Y. Curb	1¼	*98	*98	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	17⅛	17	17	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*63	*60	*63	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅛	3⅞	4⅛	May '23, Q	0.10
Columbus Rexall	Salt Lake	*51	*47	*48½	Aug. '22,	0.03
Consol. M. & S.	Montreal	26½	25	26¼	Oct. '20, Q	0.62½
Federal M. & S.	New York			7½	Jan. '09,	1.50
Federal M. & S. pfd.	New York	49	48	48½	Mar '23, Q	1.75
Florence Silver	Spokane	*38	*38	*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	9⅜	9¼	9⅜	Mar. '23,	0.25
Iron Blossom Con.	N. Y. Curb	*33⅜	*30	*33	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*15	*14	*15	June '21, I	0.02
Park City	Salt Lake	3.45	3.35	3.35	Apr. '23,	0.12½
Park Utah	N. Y. Curb			3⅛	Apr. '23	0.15
Prince Consol.	Salt Lake	*8⅛	*8⅛	*8⅛	Nov. '17,	0.02½
Silversmith	Spokane	*42	*40	*40	Apr. 23,	0.01
Simon Silver Lead	N. Y. Curb	*38	*35	*36		
Snow Storm Silver-L	N. Y. Curb	1	*90	1		
Tamarack-Custer	Spokane	1.40	1.25	1.35	Jan. '21, K	0.04
Tintic Standard	Salt Lake	3.27½	2.95	3.02½	Dec. '22, Q,X	0.10
Utah-Apex	Boston	5⅛	4⅞	4⅞	Nov. '20, K	0.25
IRON						
Bethlehem Steel	New York	60¾	53⅛	53⅛	Apr. '23, Q	1.25
Char. Iron	Detroit			2		
Char. Iron, pfd.	Detroit	3 3/16	3	3		
Colorado Fuel & Iron	New York	30½	28	28½	May '21	0.75
Col. Fuel & Iron, pfd.	New York			102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	30½	29½	29½	Apr. '23	1.00
Inland Steel	N. Y. Curb			46¼	Mar. '23	0.25
Mesabi Iron	N. Y. Curb			9		
Replogle Steel	New York	22	18½	19½		
Republic I. & S.	New York	54⅞	48⅜	49¼	May '21	1.50
Republic I. S., pfd.	New York	93	91½	92	Apr. '23	1.75
Sloss-Sheffield S. & I.	New York	55⅛	51	51½	Feb. '21	1.50
Sloss-Shef. S.&I., pfd.	New York	80	80	80	Apr. '23	1.75
U. S. Steel	New York	102	97½	97⅜	Mar. '23, Q	1.25
U. S. Steel, pfd.	New York	118	116⅛	116⅞	Feb. '23	1.75
Virginia I. C. & C.	New York	63	61	61	Jan. '22	1.50
Virginia I.C.&C., pfd.	New York	83	83	83	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	34⅜	31¼	31½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	63½	63	63½	Apr. '23 Q	1.50
Asbestos Corp. pfd.	Montreal	87	85¼	85¼	Apr. '23 Q	1.75
SULPHUR						
Freeport Texas	New York	15⅜	14½	15	Nov. '19, Q	1.00
Texas Gulf	New York	63½	60½	61½	Mar. '23, Q	1.25
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	2⅜	2⅜	2⅜		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	48	45½	46⅛	Mar. '23, Q	0.75
Amer. Metal pfd.	New York			114	Mar. '23, Q	1.75
Amer. Sm. & Ref.	New York	60⅛	56⅜	57⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	98⅜	98⅛	98⅜	Mar. '23 Q	1.75
U. S. Sm. R. & M.	New York	32¼	31⅜	32⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	44	43⅛	43⅜	Apr. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

Heavy-Duty Diamond Drill for Oil Boring

Experience in the field with diamond drills during the last two and a half years has shown the desirability of a larger, faster, and more powerful machine for handling large casings and deep wells. To meet this need, the type FK drill has been designed and built by the Sullivan Machinery Co., of Chicago. This machine is much more suitable for the class of work described than the Sullivan P-2 diamond drill, hitherto the largest and most powerful diamond drill in use in the oil fields.

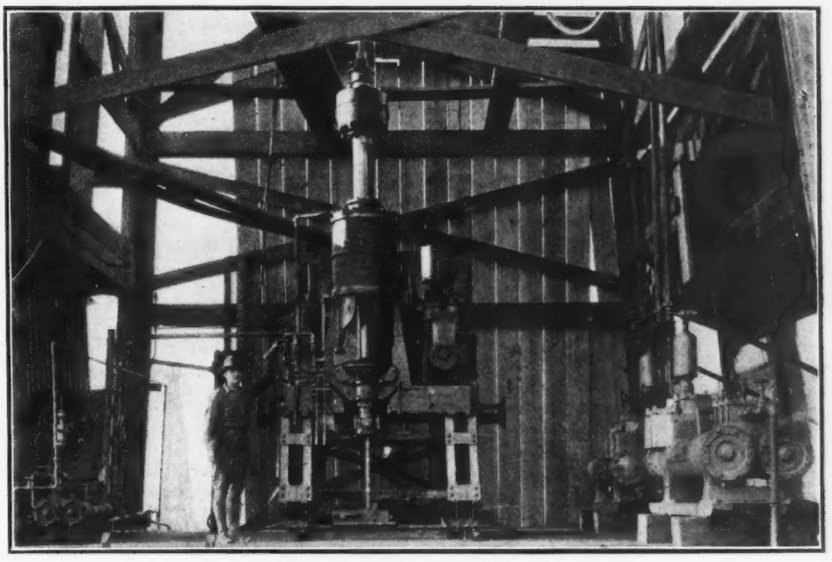
The first type FK was shipped in March, 1923, to the Shell Oil Co., of California, for the purpose of deepening producing wells about 3,000 ft. deep to depths varying from 4,500 to 5,000 ft. These wells are equipped with 6-in. and 4-in. casing.

The Class FK drill is designed to bore a 4-in. diameter hole to 5,000 ft. and to set 4-in. casing at 4,000 ft. The designers have carefully studied the field experience of the last two or three years with diamond drills, and the new machine embodies the requirements which this experience has indicated to be desirable. These features for deep hole work may be summarized as follows:

1. Variable rotative speed of the bits.
2. Increased rapidity of hoisting, together with ample lifting power.
3. Single cylinder hydraulic feed.
4. Reliability and staunchness in operation, and substantial construction to stand continuous service.

The FK drill is a large, substantially constructed and powerful machine. It is 9 ft. 3 in. in width over the catheads, 7 ft. 6 in. in length, and from the drilling platform to the top of the hydraulic cylinder is 10 ft. 9 in. in height. The engine, hydraulic swivel head and hoisting equipment are all mounted on a substantial deep box-shaped cast-steel bed plate, which in turn is set on a structural steel frame with heavy girder type shoes. The machine without the frame weighs 15,000 lb. and has a total weight, including the frame, of 20,000 lb. It is nevertheless readily handled.

The swivel head or drill spindle is of the single cylinder hydraulic feed type. The hydraulic cylinder is 24 in. in diameter and has a feeding range of 24 in., which is a length determined on after much experience in the field, as being likely to give the most satisfactory results under average drilling conditions without being unwieldy. This cylinder has the great lifting capacity of 40 tons with 200-lb. hydraulic pressure. The pressure pump supplied for this purpose will handle up to 400 lb. per square inch, so that the lifting capacity given may be increased by a large factor if necessary.



New diamond drill for oil-field work

The hollow piston rod is 8¼ in. in inside diameter, accommodating the largest size of diamond drill stem or rod.

Automobile-type transmission gears of carefully hardened nickel steel, and providing three speeds, have been designed to rotate the bits. A slow feed of 45 r.p.m. is provided for using fish-tail or mud bits of larger diameters. The intermediate speed of 137 r.p.m. is also available for mud bits and for the larger sizes of the diamond core bits—that is, those of 5 to 7 in. in diameter. The fast feed, 238 r.p.m., is used when the diamond bits of the smaller diameters—that is, under 5 in.—are being employed. In addition to this range in speeds provided by the feed gearing, is the ordinary throttle control, which gives a wide range at the discretion and under the regulation of the runner.

The hoisting apparatus consists of a hoisting drum, 2 ft. 10 in. in diameter, by 2 ft. 6 in. long, with a capacity of 600 ft. of ¾-in. or of 1-in. wire rope. The hoist is driven by Falk herringbone steel gears. On the pinion shaft is carried the brake and clutch for throwing in the hoist gears. The brake consists of a steel band lined with asbestos, and the clutch is of the disk type.

The hoist will handle a load of 16,000 lb. on direct lifts, with single line, or 80,000 lb. with four or five lines, but its great lifting power is less interesting than its speed. Three hoisting speeds are provided. With the engine running at 400 r.p.m., rope speeds of 516, 298, and 100 ft. respectively are available as controlled by three different transmission gears. These are the same gears which are used to rotate the drill bits. An ingenious arrangement of gear shifts and clutches makes this possible. Thus, any desired speed, depending on the class of work being done by the machine, can be secured with the minimum of effort, whether in setting heavy casing or in hoisting or lowering rods. Two catheads, one on each side of the machine, are provided for hauling equipment up to the machine, handling timbers, and pulling in the drill stem under gas or oil pressure.

The engine is of an unusual type not hitherto employed in the class of service mentioned. It is in reality two engines, each consisting of a single cylinder controlled by a plain slide valve. These are set at right angles to each other, one horizontal and the other vertical. The two connecting rods are set side by side on the same crank pin, so that the twisting strains which would be set up in the case of a duplex steam engine with connecting crank shaft and flywheel are obviated. The two cylinders are 7 in. in diameter by 8-in. stroke and run at 400 r.p.m., with maximum steam pressure of 150 lb., and a maximum horsepower of 80.

An interesting feature of this FK type drill is the means employed for moving it up to the drill hole and moving it away from it when hoisting is to be done. The shoes on which the drill frame rests run on heavy T rails, providing a range of 3 ft. By turning a four-way valve, water under pressure is admitted to a horizontal hydraulic cylinder beneath the frame. This cylinder positively draws the machine back from the drill hole or feeds it up to it evenly along the rail and without jar.

Device for Bad Truck Haulage Conditions

A folder issued by the Research Corporation, 25 West 43d St., New York, describes a device called "Truk-Trak," which consists of a flexible self-laying traction tread that is easily applied by one man on the rear wheels of the truck when needed—in soft ground, sand, mud, or snow. When not in use, the tread is stowed away on reels in the rear under the body of the car. Where stretches of good road may be followed by bad roads or no roads at all, as in contracting, mining and agricultural work, this accessory is expected to prove of value.

INDUSTRIAL NOTES

The Wave-Power Rock Drill

The subject of wave transmission of power was discussed in an editorial in the *Journal-Press* of Dec. 2, 1922, in which the application of the principle to rock drills was referred to. Discussion was invited, eliciting a reply from Walter Haddon, chairman and managing director of W. H. Dorman & Co., Ltd., 3 St. Bride's House, Salisbury Square, Fleet St., London, makers of the Dorman wave-power rock drill. Commenting on the statement in the editorial that a serious drawback was that "the generator must be operated comparatively close to the drill," Mr. Haddon says:

"There is no necessity for the frequent moving of the generator, as it can be placed at varying distances from the rock face, or close up—this mobility disposes of your adverse criticism. The generator, according to size, works a number of drills simultaneously or separately, and each drill can be worked off a varying length of pipe line. The generator and prime mover can be placed above ground and can be economically driven by any form of prime mover.

"The power input through the generator instantaneously and automatically adjusts itself to the varying working load to correspond with the power that the number of dustless rock drills being operated at any one time require. As soon as one or more drills are shut off or temporarily stopped, the power input automatically reduces itself to the minimum power demanded, and consequently there is no heavy idle load.

"Flexstel pipe line (made by the Dorman company) can be limited to a short working length at the drill point, and the remainder of the piping can be a permanently fixed ordinary hydraulic piping, a distinct saving in space as compared with a main line as used by compressed air.

"The flexibility and weight of Flexstel is governed by the number of flexible joints used within a given length. Flexible hose, whether metallic or armored canvas, has a comparatively short life in mining practice, whereas Flexstel for all practical purposes is indestructible, as a damaged section can be replaced in a few minutes at a minimum cost by unskilled labor.

"As the writer of the editorial has evidently concentrated upon the possible disadvantages of wave power, may we be permitted to briefly state our case in favor of wave power as proved in working practice:

"It is acknowledged the world over that the net working efficiency of compressed air is on an average of 6 per cent. whereas wave power at this its earliest stage of development is on a basis of 80 per cent of net working efficiency. For example: The standard three-drill wave-power plant under actual working conditions has proved itself to give drilling results approximately equal to a seven-drill compressed-air plant with compressor.

"Compressed air to maintain the low average of 6 per cent net working efficiency demands a constant high state of expenditure in maintenance, which is a costly luxury for the user but a profitable source of income to the manufacturer (denied to the wave-power manufacturer), and which fact the user will do well to bear in mind when making a capital expenditure. In support of this statement we give particular examples:

"Wave power does not demand a constant expenditure to insure tight-fitting pistons, which is an absolute essential necessity to get the 6 per cent efficiency of compressed air. If a wave-power hammer becomes worn (as by necessity it must), its replacement cost is limited to the cost of the hammer only, and as these are standardized and interchangeable, the cost is infinitesimal, and no serious waste of time and labor is involved in replacing, as the work can be done by unskilled labor and there is no measurable reduction of efficiency. In replacing a wave-power hammer it is not necessary to have a *new* wave-rock-drill body, or to go to the expense of time, labor and money to regrind the old one, which is always necessary in the case of an air drill—an extremely expensive luxury for the user.

"In the Wave-Power rock drill the number of working parts is extremely small as compared with compressed air. Only a few parts are subject to any considerable amount of wear, and these parts, made of the best material, are heat-treated in the most beneficial manner, which is not always possible in dealing with a similar unit of a compressed air plant.

"In actual practice the replacements necessary are the packings, and in their case they have an approximate average ordinary and regular life of at least 400 ft. of hard rock drilling, which shows a considerable advantage over the packings used in compressed air plants. The generator packings do not require to be replaced under a month. All these packings are inexpensive and can be quickly replaced without difficulty by absolutely inexperienced labor.

"The Portability of a Wave-Power rock drill, as compared with its capacity of output, is all in favor of its utility and acceptability under most actual working practice. Apart from this convenience, a considerable saving is to be made in the direction of eliminating fixed long lengths of pipe line, and their maintenance.

"A summary of the present advantages (and others will follow) is: a power and time saving of over 50 per cent. with double the speed of drilling, and by its results giving a corresponding decrease of overhead charges. Increased portability of Wave-Power plants in comparison being very little more than half the weight of an air plant with compressor of the same power for the same output. The simplicity of the mechanism of the plant, as there is no value gear, and no mechanical springs are required. In the latter case the basic principle patent of the system—namely the compressibility of liquids—is used as the spring. The automatic facility under the control of the operator, whereby the running water conveying the power converts all the rock débris into liquid sludge, and as a result the drill is always working on virgin rock face, and this result is secured without increased equipment or power costs. The prompt and continuous clearance of débris eliminates the cushioning effect associated with air drilling, and the natural result is the drilling speed of a Wave-Power drill correspondingly increases. Dry drilling, if required, can be done on a closed water pipe line and does not involve any serious or expensive alterations in the wave equipment. To secure this there are no separate hose pipe connections or storage tanks. The water passes down the center of the drill steel and prolongs its life, also the life of the operator, for it definitely prevents miner's phthisis.

"The Wave-Power drill possesses exclusively an independent and automatic synchronized rotation of the drill steels on the return stroke of the hammer. No splines are used, and any standard drill steels from 1 to 4 in. bits can be used in the same chuck. The high frequency makes for ease in collaring holes, as wave-power impulses arrive continuously at all lengths of the stroke from zero. Where the drilling hole traverses fissures or joint planes or is drilling near a faulted zone there is distinct reduced jamming of the wave-driven drill. The standard Wave-Power plant gives 2,400 blows per minute, and if necessary these frequencies can be increased or decreased.

"Plants can be made of varying sizes, but the plant that appears to be meeting with the approbation of the trade is the standard plant working three or four drills simultaneously or separately. This number of drills can be successfully worked all at the same time on varying lengths from 1,000 ft. to 60 ft., and no dangers or difficulties arise if the operator discontinues working one or all at the same period, or at varying times, and the working pressures under all conditions are within safe limits.

"It will interest your readers to know that there are three divisions of wave-power application to practical mechanics: (1) the percussion or reciprocating principle proved by the Wave-Power plant described; (2) the impulsive principle proved by the use of 30,000 sets of the C. C. Synchronized Interrupter Gear, the only successful method used in the Great War by the British and Allied air forces for automatically firing the airplane machine gun and always passing the bullet between the propeller blades at any speed, and the mechanism was also used for testing ammunition; (3) the rotary principle in its early stages of development has been proved practical by a speed reduction gear with a 10 to 1 reduction operated through a three-phase rotary Wave-Motor."

Handy & Harman Elect Officers

At a meeting of the stockholders of Handy & Harman, 59 Cedar St., New York, held April 19, 1923, the following were elected directors: John F. Harman, Parker D. Handy, Harry DeLoss, William B. Sewell and Walter H. Bennett. At a meeting of the newly elected board of directors, held April 25, John F. Harman was elected chairman of the board; Parker D. Handy, president; Cortlandt W. Handy, George C. Gerrish and G. H. Niemeyer, vice-presidents; J. L. Brush, treasurer; and Cortlandt W. Handy, secretary. Harry H. DeLoss, who has been associated with the corporation for twenty years, is retiring from active participation.